Ethiopia
Conditions for Pico/Mini Hydro Power Grid Connection

July
2008

Experiences from Countries with Micro Hydro Power and other renewable energy systems feed-in to existing Grid

This report shows experiences and samples from different countries in respect to feed-in of renewable energies into grid systems. It is to be considered to give hints for further elaboration on the issue for the acceleration of processes for broader use of hydro power in rural electrification systems.

Contents

1 Introduction

Feed-in Tariffs (FITs) in brief – A short overview on the philosophy behind it

1.1 How does it work?

Feed-in Tariff s (FITs) are laws which establish legal guarantees to support the market development of renewable energy technologies, specifically for electricity generation. The guarantees cover:

- grid access, by obliging utilities to accept the electricity;
- price, by scientifically determining a tariff rate for each technology that pays enough to ensure profitable operation;
- duration, by setting a time limit on how long the payments are received – the best examples are long, around 20 years.

These guarantees ensure low investment risk, and therefore access for all levels of producer, and allow all technologies to receive a fair price and therefore help them to compete fairly with conventional energy.

1.2 Which other countries have a feed in tariff?

Over 40 countries, states and provinces now have FIT systems. Germany, Italy, Spain and Denmark are clear world leaders in renewables largely due to this law. It is used in most European countries, as well as in various Indian states, in Ontario, Canada, in Latin America – even on the island of Mauritius to pay sugar companies to generate electricity from sugarcane waste material (bagasse). FIT laws are proposed for implementation in countries as diverse as Australia, Mongolia and South Africa.

1.3 Why is the German model compared to others so successful?

It has been in development longer than most, and enjoyed sustained support. Regular review and maintenance is part of the law, ensuring that tariff rates are adjusted as technologies improve – which the law helps to stimulate by reducing payments to technologies annually; costs are also shared equally, reducing the burden on end consumers, who pay only around 1,50 € per household per month extra. They set no limit to the amount of RE that can be generated and incorporated. Their industrial capacity has been developed by the law – the sector employs close to a quarter of a million people, and now they see RE as an essential part of the economy, as well as part of the strategies tackling energy security and climate protection.

1.4 What policies do other countries use instead of feed in tariffs?

The quota system is perhaps the most common alternative, used in countries such as the UK (known as the RO or Renewable Obligation), US (there known as RPS, or Renewables Portfolio Standards) and Japan (also known as RPS). These

laws set the amount of RE capacity to be generated, but not the price. The Tendering system is a mechanism in which RE developers bid for power purchase agreements and/or access to a government-administered fund through a competitive bidding process. Regulators specify an amount of capacity or share of total electricity to be achieved, and the maximum price per kWh. Project developers then submit price bids for contracts. Governments set the desired level of generation from each resource, and the growth rates required over time.

1.5 Why apparently aren't these as successful in promoting the take up of renewables?

Quota systems generally offer one price, which inevitably means that companies look to use the cheapest technology. This leads to neglect of other technologies, stifling the market, and also to much higher investment risk, which only large utility companies can bear. This secures their market, keeps smaller investors out, including householders – and costs more money, paid by taxpayers. Tendering systems perform poorly as the nature of competitive bidding often leads to unrealistically low bids, and inability to complete the project.

1.6 If the feed in law is so good, why hasn't it seen more widespread adoption?

This is most likely due to a combination of factors. Ideological reasons are commonly detected by analysts – they wish to take the most market-friendly route. Governments are said to believe that quota systems offer more compatibility with the electricity market, and that FITs interfere with the market more. Also, relationships between governments and large energy companies are almost certainly a factor. FITs have been commonly opposed by these companies for the above reasons, although they argue various other points. A response paper by the Federal Environment Ministry in Germany showed that all the arguments from the conventional energy industry had no standing, and that FITs are best for society as well as RE producers. FITs have been empirically proven, in a great many studies, to deliver the fastest, lowest cost, most technologically-diverse deployment of renewable energy.

2. Energy, ethics and feed-in tariffs[1]

Also after intensive researching and writing on feed-in tariffs (FITs), one may be still amazed at how many people haven't heard of them — especially people who by rights should be shouting the subject from the rooftops. That concerns especially environmental campaigners, but also to the "can-do" types who see in renewable energy a personal economic opportunity and/or a chance to relieve the pressure on the climate system.

[1] *Widely after Miguel Mendonca, World Future Council, January 10, 2008*

As already discussed in chapter 1, a short explanation of FIT laws will be that:

- they place a legal obligation on utilities to purchase electricity from renewable energy installations.
- The tariff rate is guaranteed, and in the best examples, for a long period — say 20 years.
- The tariff rate is scientifically determined for each technology, to ensure profitable operation of the installation.

There are different design options for the law, including tariff degression; this reduces the rates each year — meaning for example that PV gets a lower rate if you install next year than if you install this year.

- one, it encourages swift take-up;
- two, it encourages manufacturers indirectly to increase design efficiency.

If one is going to receive a lower rate, one may generate more electricity. This drives innovation, making renewable energy a more rapidly evolving field — which is precisely what is mostly expected.

The costs of the scheme should be shared among all end-users, so that no-one is overly burdened. In Germany (perhaps the most effective system, developed and supported politically since 1990), their law has made them a world leader in renewable energy, generated billions of dollars a year in exports, created in the region of a quarter of a million jobs, saved towards 100m tons of CO_2 annually in recent years, and set records for installed capacity across many technologies — all at the cost of around €1.50 per household, per month.

These results are staggering, especially in contrast with the results of other policies, in other countries.

So, how to stimulate discussion? How can one present energy and the environment in a context which moves people to actually act? For the World Future Council, it is the moral and ethical case — although the Council has no hesitation about dangling the economic carrot. The ethical factor has been critical in many of the major social and political changes that have occurred in modern history, affecting slavery, suffrage, warfare, labour and human and civil rights.

The link between ethics and renewable energy is short and clear: one doesn't have the right to destroy the conditions for life on earth by continued use of climate-damaging energy sources; they should be replaced with clean, safe, abundant and geopolitically-benign renewable energy; the mechanism proven to deliver the fastest, lowest-cost renewable energy deployment is the feed-in tariff (FIT).

There are clear problems (environmental protection, energy security, etc.) and a clear solution. It works extremely well for the European countries who have become world leaders in renewables, and the law has helped to raise awareness, participation and support for renewables.[2]

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[2] See Craig Morris's recent 'RE Insider' piece on Former U.S. Vice-President Al Gore's proposed 'electranet': Gore is essentially endorsing the concept of FITs, by another name.

The alternatives to FITs are poor by comparison. In this context, they tend to be one or all of the following: inefficient, inequitable, ineffective and expensive. The UK scheme is, sad to say, embarrassingly replete in terms of these shortcomings. In a recent documentary made for BBC World on feed-in tariffs, entitled "Pay-back Time", the UK government was invited to comment, comparing the systems and performance of the two countries. They declined.

Certain German utility companies that have relentlessly fought the German law — because it threatens their market domination — were invited to state their case. They declined. Despite this, the documentary provides a whirlwind tour of how the system has succeeded in Germany, as well as in Mauritius, where it is used to provide the sugar industry with funds from burning waste 'bagasse' to generate electricity.

So, why have more countries not pursued this course? The reasons are open to conjecture, but a common suggestion concerns the preference in certain countries for market-based solutions to — everything.

While it is true that markets are often excellently self-organizing, with many concomitant benefits, fossil fuels are not sufficiently required to address the damage that they cause to life on earth, and they continue to attract large subsidies — in itself a market distortion. Ernst Ulrich von Weizsaecker, founder of Germany's Wuppertal Institute, referred to this as "telling the ecological truth".

Hitherto, the market has indeed been deafeningly silent on this issue. Such subsidies run against all sense — in terms of health and survival. Instead of the polluter paying appropriately, energy users are paying the polluters. If conventional energy was priced in terms of environmental externalities, it would in all likelihood be simply uneconomical. Thus, the market ideology is often self-deceiving and arbitrary.

But why do governments choose not to take the decision to end climate damaging subsidies, even if emissions reduction targets demand it? How many opposition governments even have this as part of their manifesto? Conventional energy still provides many jobs. The subsidies are entrenched. The energy infrastructure is built around conventional energy. Energy companies are extremely powerful entities who brook no competition. The market and regulation environments are still set up to reward them for their behaviour. However, recent legislative moves in the U.S. on the EPA regulating CO_2 emissions may well help the push in the opposite direction.

But - what will the response be from the energy industry? 'Clean' coal? Nuclear - green washed into appearing to be an environmental saviour? The quote that "for fifty years, nuclear has been a solution in search of a problem" is as pertinent as ever. How could the environmental movement have spawned such an opportunity for people to throw money at its old enemy? The irony is deeply felt, and with one eye on the attractiveness of large, controllable, centralized solutions — certain governments are only too delighted to get on board.

However, Silicon Valley and its equivalents in Germany, Spain, China, India and elsewhere are working around the clock on the real energy innovations. Renewables will be the biggest business in the world - if we are to seriously address the

needs of future generations, never mind their wants. With so much at stake, and such a clear moral duty to these future generations, the natural place to start is with the best method of deploying renewables — and that is proven to be FITs.

3. FIT-Law[3]

3.1 What is a FIT law?

Faced with the need to increase the amount of electricity generated by renewable energies, governments must choose from a range of policy options. A **Feed-In Tariff** law is the best available mechanism for accelerating the uptake of renewable energy in grid-connected areas.

Not only this, but a good FIT system is a truly democratic policy - one which makes it cost-effective for people to generate their own clean electricity; one which returns power to the people.

3.2 How do FITs work?

FITs oblige energy companies to buy renewable energy from producers, and sets the price which these companies pay per unit of electricity. By guaranteeing access to the grid and setting a favourable price per unit of power, FITs ensure that renewable energy is a sound long-term investment - for companies, for industry, and for individuals - thereby creating a strong economic incentive for investing in renewables.

The most common method for funding the FIT involves sharing the costs amongst the end-users. The result being that the increase in price per household is very small.

[3] Proposals worked out by:

PACT Policy Action on Climate Toolkit

World Future Council

3.3 What are the benefits of a FIT law?

When designed effectively, FITs are proven to:

- **Reduce CO_2 emissions** by replacing fossil fuel-based power production with clean, renewable sources of energy
- **Create jobs** - for example the German renewables industry employs around 234,000 people. Almost 60% of which were employed as a direct result of the German FIT law.
- Help **secure domestic energy supply** - enabling countries to stop relying on imported fossil fuels
- **Guarantee investment security** for renewable energy investors
- **Drive technological innovation**, and
- **Provide fair market conditions** for renewables which without this system, compete with heavily-subsidised conventional energy.

3.4 Common criticisms

FITs are often rejected for being 'interventionist' - for interfering in the free market - and for being inefficient or ineffective as a result.

All renewable energy support mechanisms are interventions in the market. What makes FITs unique is that they have proven to be the most effective mechanism for increasing the uptake in renewable energy, and the best at creating market growth.

It is also worth noting that those who argue that FITs are interventionist frequently advocate some form of quota system or 'renewable portfolio standard'. But quota systems are just as interventionist: while FITs fix the amount to be paid for the electricity, and allow the market to determine the amount of electricity generated; quota systems fix the latter, and allow the market to determine the former.

Sometimes, FIT laws are called Advanced Renewable Tariffs, Feed Laws or Renewable Energy Feed-in Tariffs (REFITs). The key question is not their label, but whether they effectively address the above objectives.

It is important, though, to know what is not a FIT law.

3.5 What is not a FIT law

There are many kinds of support mechanisms promoting electricity supply from renewable sources, with all kinds of names, all over the world. Whilst they can be combined with FITs, it is important to distinguish FIT laws from the following:

Quota Systems (RPS) and Tradable Green Certificates

Under Quota Systems the government sets a target for renewable electricity production that increases over time, building a market for renewable electricity. Most Quota Systems allow the target to be met by producing the

renewable energy directly or by purchasing "credits." For the trade of those "credits" an additional mechanism called Tradable Green Certificates or Renewable Energy Certificates or Credits is usually established. Read more in Annex 1 about **examples** in the **United States** and **Europe**.

3.6 What should be in a good FIT law?

A good FIT law has two main objectives and several supplementary objectives.

The Access Objective

Grid operators are obliged to connect renewable energy producers to the grid, whether the producers are utilities, other businesses or private households, and must transmit the electricity they produce. To achieve the Access Objective, grid-related features need enacting.

The Price Objective

The price for the electricity produced is set at a level and for a period that guarantees a reasonable return on investment. To achieve the Price Objective, economic and financial features need enacting.

Supplementary Objectives

The Supplementary Objectives are important for the fine-tuning of the FIT law. To achieve them, additional features need enacting.

3.7 Hints for drafting a good FIT law

Before one starts drafting...

... one needs to consider whether the expected country or region is suitable for a FIT law.

There are **three key questions** that will help to determine the suitability of a country or region for a FIT law. Answering 'yes' to these will help to ensure smooth and effective progress in enacting a FIT law.

a) Does the country or region have an appropriate electricity grid?

FIT laws support grid-connected electricity generation from renewable energy sources. FIT laws don't work for off-grid electricity production, where other support instruments are more appropriate, such as direct investment incentives, micro-credits and tax and investment incentives.

Obviously, the more extensive the grid, the better. This will mean more power plants get connected. But more importantly, is there grid access in the areas with the best resource conditions?

In answering this question, it might be necessary to consider drafting a new, or amending a current, **national grid extension plan**. This could be done in conjunction with an analysis of resource availability.

National grid extension plan

Preparation of these plans is normally managed by the independent grid operator. If the grid is not independently managed, or the grid operator is reluctant to carry out such a plan, another independent and qualified body can be appointed for this task. These plans can also be worked out in cooperation with international organizations active in the field of renewable energy deployment, e.g. the World Bank or the Asian Development Bank.

For large scale renewable electricity projects, bottlenecks in the transmission and distribution system network have to be identified to guarantee grid stability. Insufficient grid capacity is often the major constraint for renewable energy projects.

b) Does one know the country or region's resource availability?

Renewable energies are domestic resources. Around the world, electricity production from renewable energy sources is possible but the resource availability varies largely for each single technology. For instance, there might be very good wind conditions in some areas but no good sites for geothermal electricity generation. Every support programme should therefore start with an understanding of the national or regional resource availability. It might be necessary to carry out a tailor-made analysis.

Resource availability also tends to impact on the FIT tariff (or price). As a general rule, lower tariffs (or prices) apply in areas with relatively good geographic conditions. Slightly higher prices might be necessary under sub-optimal conditions.

International and national programmes might have begun working out the resource availability in different countries and regions.

Resource availability resources

The United Nations Environment Programme (UNEP) maintains a database and website with solar and wind resource maps and data for a number of countries and regions, known as The Solar and Wind Energy Resource Assessment (SWERA). Small hydro power assessments are also being developed. Currently funded by NASA, its mission is to provide high quality information in suitable formats, along with the tools needed to apply these data in ways that facilitate renewable energy policies and investments: http://swera.unep.net

In the U.S., the Department of Energy's Wind and Hydropower Technologies Program maintains a State wind resource map and other information:

http://www.eere.energy.gov/windandhydro/windpoweringamerica/wind_maps.asp

c) Is there likely to be sufficient political support?

Passing laws needs political support. This support might already exist, or, if not, will need to be built.

One shouldn't be deterred if political support needs to be built. There are many reasons to introduce a FIT law, and the beauty of a FIT law is its democratic nature: it can benefit everybody, from individual households through to large companies, whether urban or rural, whether commercial or not-for-profit. And at the same time, security of supply, stable electricity prices in times of increasing fossil fuel prices, environmental benefits, job opportunities, and supporting rural areas are all examples of the wider social benefits. The possibilities of building political support will exist everywhere.

Experience shows that FIT laws have best worked in countries with a broad political consensus, both for support of renewable electricity in general and for the choice of support mechanism in particular. The most successful countries (e.g. Spain and Germany) have relied on a FIT law for more than a decade, thus providing a stable political framework. Green Party politicians were critical in developing the French and German FIT laws, as was a strong alliance between green groups and the existing renewable industry. This political consensus is the only way to avoid the shift from one support mechanism to another which might hamper investors' confidence and sustainable growth of the renewable electricity sector.

Following one can learn more about the advantages of **strong alliances**, **regional capacity-building** and actors that might be **opposed** to the implementation of a FIT law.

Strong alliances

Key to building political support is forming a strong alliance across many parts of society. Examples from countries with an outstanding renewable energy record show political parties, governmental actors, NGOs, environmental organisations, industry associations, utilities, financial institutions, labour unions and research institutes pulling together. In Ontario for example, farmers were an important group supporting introduction of the FIT system.

Regional capacity-building

For the support of renewable electricity, it is equally important to start capacity-building at regional level at an early stage, as in many cases regional authorities will be responsible for the administrative handling of renewable energy projects. Local and regional authorities have to be informed about the benefits that renewable energies will bring about for their region.

Possible opposition

Opposition to the support of renewable energies in general and the establishment of a FIT law in particular might come from the conventional energy industry. The industry might fear decreasing market share, especially in the case of stagnating or decreasing electricity consumption. Moreover, grid operators might fear an additional administrative burden that they will not be compensated for.

Opposition from some members of the local public is also possible (NIMBY-ism: not in my backyard). Even though support for renewable energies might be broad in the society, project development in the immediate neighbourhood of people can be rejected. To weaken this effect, it is recommended to include the local public in the decision-making process for plant locations or to facilitate a share of the financial profits to the community (either by direct financial participation in the project or tax revenues).

Answered 'yes' to all three?

If there is compliance that the country or region has an appropriate electricity grid, one has checked out the resource availability, and one reckons there's likely to be sufficient political support, then one can safely say that the country and region is suitable for a FIT law.

The next thing to do is to make sure to know what should be in a good FIT law.

The World Future Council is working to promote FITs and has produced a guide for politicians that outlines the basics of feed-in tariff systems.

Examples for a FIT law regarding small hydropower are given in Annex 2, 3, 4, 4a and 5.

3.8 Pre-conditions for a Successful Feed in Tariff System

If feed-in tariffs are the most successful system for accelerating renewable energy deployment, what conditions need to be present for these policy instruments to actually work?

1. Social acceptance and enthusiasm needs to be widespread for transitioning from fossil to renewable sources of energy, allowing marginal increases in electricity cost in exchange for cleaner energy. Some social and political patience will be essential in meeting inevitable challenges and adjustments required to work out the nuances of any new program.
2. The tariffs should be set at a price that compensates plant builders for their costs plus a reasonable profit.
3. The tariffs need to be guaranteed for a period of time (10 to 20 year contracts) that assures return on investment and the law itself should be in effect for as much as a decade or longer to create a more stable investment climate for renewables. If some technologies no longer require this protection they can be phased out of the coverage of the tariff sooner than other technologies.
4. A tariff law that encompasses a wide variety of technologies helps balances the strengths and weaknesses of each generating technology. Including residential, community and wholesale generation technologies will help push renewable energy development on all fronts.
5. Tariffs should "degress", go down in price, with each successive class-year of generators to encourage early action and increases in industry efficiency.

A feed-in tariff system will become obsolete when costs are brought down and prices for fossil fueled generation inevitably rise.

6. A pooling mechanism for sharing costs of the tariffs should be instituted and spread across as wide rate base as possible. Within that rate base, costs need to be shared equitably.
7. Resolving physical or social barriers to energy development such as transmission or assessment of environmental impacts should be standardized, transparently negotiated with all stakeholders, and compressed in time given the urgency of increasing the proportion of renewably generated electricity in the generation mix.
8. Energy investment should be open to and remunerative for all types of investor through both cooperative and large corporate investment vehicles. In deregulated markets, barriers to utilities investing in generation directly need to be amended to allow utilities to profit from feed-in tariffs alongside other investors.
9. A financial system that recognizes the value of the tariff's purchase agreement and loans money accordingly is key; sometimes public lending institutions can pioneer lending for early projects to demonstrate the viability of the system to private-sector banks.

If the above conditions are present or can be created, success with a feed-in tariff system is highly probable.

Useful links:

- The International Feed-in Cooperation: http://www.feed-in-cooperation.org/
- Paul Gipe's site (Wind-Works): http://www.wind-works.org/
- The Renewable Energy and Energy Efficiency Partnership (REEEP): http://www.reeep.org/
- The Renewable Energy Policy Network for the 21st Century (REN21): http://www.ren21.net/
- The German Federal Ministry for the Environment, Nature Conservation and Nuclear safety [renewable energy page]:

  http://www.bmu.de/english/aktuell/4152.php

4. Country- and region-specific information on Feed-in Programs - Worldwide

Since 1978 46 countries of the world have started feed-in programmes:

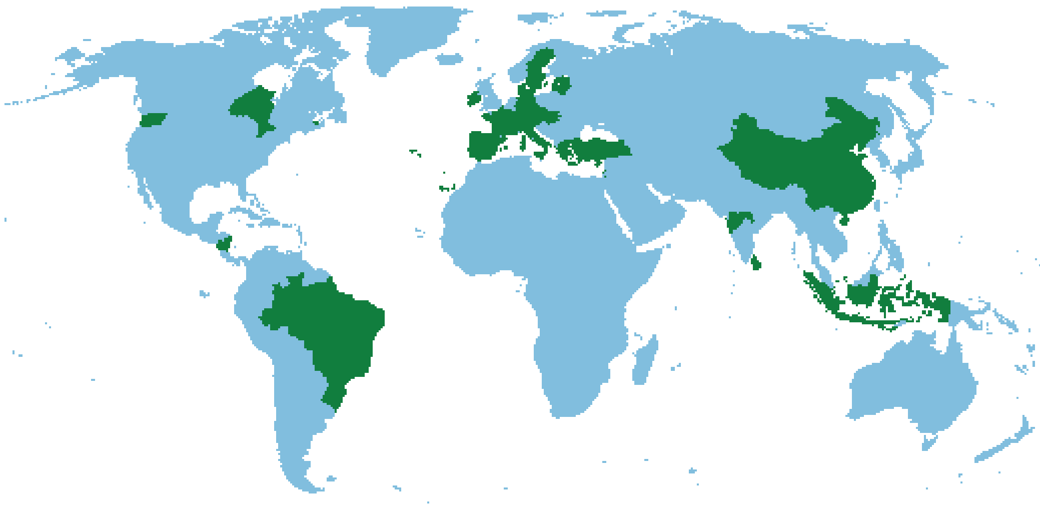
Table R10. Cumulative Number of Countries/States/Provinces Enacting Feed-in Policies

Year	Cumulative Number	Countries/States/Provinces Added That Year
1978	1	United States
1990	2	Germany
1991	3	Switzerland
1992	4	Italy
1993	6	Denmark, India
1994	8	Spain, Greece
1997	9	Sri Lanka
1998	10	Sweden
1999	13	Portugal, Norway, Slovenia
2000	13	—
2001	15	France, Latvia
2002	21	Algeria, Austria, Brazil, Czech Republic, Indonesia,Lithuania
2003	28	Cyprus, Estonia, Hungary, South Korea, Slovak Republic, Maharashtra (India)
2004	34	Italy, Israel, Nicaragua, Prince Edward Island (Canada), Andhra Pradesh and Madhya Pradesh (India)
2005	41	Karnataka, Uttaranchal, and Uttar Pradesh (India); China; Turkey; Ecuador; Ireland
2006	44	Ontario (Canada), Argentina, Thailand
2007	46	South Australia (Australia), Croatia

Source: Global Status Report on Renewables 2007 (www.ren21.net)

At first only industrialised countries showed interest in this new policy. But since 2002 also developing countries can be found on the list.

The World Future Councils has produced a worldwide overview of countries already practising feed-in programmes for electricity supply:



Countries with Feed-in Programmes

USA

The Public Utility Regulatory Policies Act (or PURPA) was a law passed in 1978 by the United States Congress as part of the National Energy Act. It was meant to promote greater use of renewable energy. This law created a market for non-utility electric power producers forcing electric utilities to buy power from these producers at the "avoided cost" rate, which was the cost the electric utility would incur were it to generate or purchase from another source. Generally, this is considered to be the fuel costs incurred in the operation of a traditional power plant.

PURPA was actively implemented by many states during the 1980s. By the 1990s, fewer states still had active PURPA implementation, although currently several states still implement PURPA as a feed-in tariff for small projects; examples of this exist in Idaho, Minnesota, and Oregon.

US State Law - Washington State

The State of Washington has a law that could be described as a step toward a FIT -- Senate Bill 5101, codified as RCW § 82.16.110 – 82.16.140.

Summary

SB 5101 does not require the electricity produced from renewable sources to be connected to the grid, so we cannot call this a true FIT program.

Senate bill 5101 is an investment cost recovery programmme for individuals (and businesses, etc.) that installs qualified renewable energy facilities on-site to produce power they will use on-site. The property for which someone is claiming the incentive must be connected to the grid. The power produced reduces the amount of power that would have to come from the grid, but the power itself does not necessarily get sold to the grid.

The law does not require connection to the grid, and in fact, originally did not allow connection to the grid. When SB 5101 became law, Washington did not have uniform standards for interconnection. The law says that once the utilities covering 80% of the customer base have adopted uniform interconnection standards, then customers can apply for incentives for both interconnected production and non-interconnected production. This 80% requirement has now been met, so customers can apply for cost recovery incentives for energy produced from certain renewable resources whether or not the energy produced is connected to the grid.

Utilities are not required to participate in the program, so there is no guarantee that customers generating electricity from renewable sources will be able to obtain the incentives.

Hawaii

Hawaii State Representative Scott Saiki introduced a bill creating a feed-in tariff for Solar Energy on January 24, 2007 (HB 1748). It was referred to the Energy and Environmental Protection Committee on January 26, and carried over to the 2008 regular session on August 27, 2007.

One can find the text at:

http://www.capitol.hawaii.gov/session2008/Bills/HB1748_.htm

One can track its progress at:

http://www.capitol.hawaii.gov/site1/docs/getstatus2.asp?billno=HB1748

Canada

Ontario

Ontario has a FIT policy, enacted in Standard Offer Program: Renewable Energy: Final Program Rules (SOP), version 2.0, 22 Nov 06 (English).

Summary

In 2004, the Ontario government set a target for the province to produce 5% (1,350 megawatts) of its electricity from renewable sources by 2007 and 10% (2,700 megawatts) by 2010.

In May 2005, the Ontario Sustainable Energy Association reported, as requested, to the Ontario Minister of Energy, on the policy options to encourage small or community-owned renewable energy generation in Ontario.

Following a subsequent request by the Minister of Energy, on March 17th 2006 the Ontario Power Authority (OPA) and the Ontario Energy Board made joint recommendations on a Standard Offer Program for small generators connected to a distribution system.

On 22nd November 2006, the OPA published its Renewable Energy Standard Offer Program rules.

Under this Program, operators of small renewable energy generation facilities connected to the grid with a connection voltage of up to 50 kilovolts and with separate suitable metering that provides usually hourly data have the right, for 20 years, to sell their electricity under contract to the Ontario Power Authority, at guaranteed technology-based fixed prices, partially adjusted by inflation, and with an additional premium or incentive payment for peak-hours supply, provided they meet the application eligibility criteria and meet the costs of connection, subject to system constraints [see Ontario example under Ensuring connection to the grid].

Prince Edward Island

Prince Edward Island, Canada's renewable energy law creates a hybrid program. The law is the Renewable Energy Act, R.S.P.E.I. 1988, c. R-12.1 (English).

Summary

The law requires public utilities to obtain at least 15% of the electric energy it sells from renewable energy sources by 2010 [sec. 3 (1)]. Renewable energy sources are defined broadly and may include large hydro [sec. 1 (1)(u)]. The law also requires utilities to adopt demand side management plans to reduce the peak demand for electricity [sec. 6 (1)].

There is a prescribed minimum rate for electric energy purchased from municipal renewable energy generators, and medium or large capacity renewable energy generators [sec. 8 (1)].

Middle America

Nicaragua

Nicaragua has a FIT program.

Several laws make up the program including, Ley para la Promocion de Generacion Electrica con Fuentes Renovables, Ley 532/05 (Law for the Promotion of the Generation of Electricity from Renewable Sources), and Ley de Reforma a la Ley No. 467, "Ley de Promocion al Sub-sector Hidroelectrico", Ley 531/05 (Law reforming Law No. 467, "Law for the Promotion of the Hidroectric Sub-sector").

Summary

Law 532/05 describes the basic FIT program. The law applies to new projects as well as expansions of installed capacity at existing renewable energy facilities. The law applies to energy generated from hydro, wind, solar, geothermal, biomass, and other sources.

South America

Brazil

Brazil has a FIT law.

The current law is "Dispõe sobre a expansão da oferta de energia elétrica emergencial, recomposição tarifária extraordinária, cria o Programa de Incentivo às Fontes Alternativas de Energia Elétrica (Proinfa), a Conta de Desenvolvimento Energético (CDE), dispõe sobre a universalização do serviço público de energia elétrica" Lei Nº 10.438, de 26 de Abril de 2002.

Summary

According to the International Energy Agency:

"The Brazilian Parliament passed Law 10438 in April 2002. Law 10438 was responsible for the creation of the Programme of Incentives for Alternative Electricity Sources (Programa de Incentivo a Fontes Alternativas de Energia Elétrica-PROINFA) among other programmes. The PROINFA programme is to be implemented in two stages:

"STAGE 1: 3,300 MW of renewable energy (from wind, biomass and small hydroelectric sources) will be brought on stream before the end of 2007 through a system of subsidies and incentives, which draw on an Energy Development Account funded by end-use consumers through an increase on energy bills (low-income sectors are exempt from this increase). Under the PROINFA rules, the programme will be operated by Electrobrás, which will buy energy at pre-set preferential prices ("economic values" for each of the three sources) and will market "renewable" electricity. Definitive "economic values" will be published at the end of October 2003 and will have a reference value floor of 70% of the national average supply tariff. Contracts between Electrobrás and the "renewable" generator are valid for a period of 20 years, are applicable to plants that began production before 2007 and must be signed within 24 months of the publication of Law 10438. . . .

"STAGE II: Once the 3,300 MW objective has been met, PROINFA will target increasing the share of electricity produced by three renewable sources to 10% of annual consumption within 20 years. In Stage II, PROINFA renewable generators will be required, before December 30th of each year, to issue a number of Renewable Energy Certificates proportional to the amount of clean energy produced by the plant."

Asia

China

China has a FIT law. The main law is the Renewable Energy Law (2005) (authorized English translation). Other laws that make up part of the program include Trial Measures for Pricing and Cost Sharing Management for Renewable Energy Power (non-authorized English translation) (2006), and Chinese RE Law: Management Guidelines (non-authorized English translation) (2006).

Summary

China's law applies to energy produced from wind, solar, water, biomass, geothermal, the ocean, etc.[Renewable Energy Law (2005) chp 1, art. 2]. The law requires grid operators to purchase energy produced from qualifying renewable resources and connect the power to the grid. The law says, "Grid enterprises shall enter into grid connection agreement with renewable power generation enterprises that have legally obtained administrative license or for which filing has been made, and buy the grid-connected power produced with renewable energy within the coverage of their power grid, and provide grid-connection service for the generation of power with renewable energy" [Renewable Energy Law (2005) chp 4, art. 15]. The law requires State Councils to set the price for purchasing electricity from renewable resources. The prices should be "beneficial to the development and utilization of renewable energy and . . . economic and reasonable . . . ." [Renewable Energy Law (2005) chp 5, art. 19]The State Councils may make adjustments to the prices. Id. "The price for grid-connected power shall be publicized." Id.

India

India does not have a national FIT program. The central government encourages states to develop programs to promote production of electricity from renewable sources. In India, national feed-in tariffs (common guidelines to all states for a minimum buy-back rate of Rs. 2.25/kWh in order to bring uniformity) were declared by MNES in 1993. However, two states, Gujarat and Tamil Nadu, were offering attractive buy-back rates even earlier in order to attract private sector investment in wind (MNES annual reports for 1991-1994). Similarly, Maharastra and Tamil Nadu had promotional policies for bagasse-based cogeneration. Tamil Nadu had evolved a scheme in 1988 (TNEB-Tamil Nadu Electricity Board Notification dated 12 December 1988) called "Power feed scheme" permitting cogenerators and private-sector power producers of 2 MW capacity and greater to sell surplus power to the grid. It covered co-generation units, mini- and micro-hydro, wind farms, and diesel/gas turbines. The power purchase rate for this scheme in 1990-91 was Rs. 1.00 per unit subject to yearly review. MSEB (Maharashtra State Electricity Board), on the other hand, offered Rs. 1.20 per unit with periodic revisions. (Source for both the above is Winrock International & IDEA 1993.)

India's Electricity Act of 2003 mandates national targets by 2012 and provides guidelines for fixing RPS and feed-in tariffs for each state.

Summary

In 2001, the Prime Minister of India announced a goal of producing 10% of the new planned capacity over the next ten years from renewable resources.

Following central government policy, 15 states have announced policies for grid connectivity of renewable energy projects. The State of Maharashtra created a tariff for solar power.

Legal analysis

Read more information about laws and policies encouraging the development of renewable energy in India.

More information

Private participation in Energy Generation through non-conventional Sources. Policy on cogenration of electricity. GOVERNMENT OF MAHARASHTRA. Industries, Energy and Labour Department. Government Resolution No. PSP 1097/CR-68/NRG-7 Mantralaya, Mumbai - 400 032. Dated the 18th October, 1997.

SOLAR / WAVE POWER PLANT POLICY

Unofficial Translation of G.R. Policy on generation of power through solar energy e.g. solar thermal, solar photovoltaic, solar photo-synthesis, wave energy etc. Government of Maharashtra. Industries, Energy & Labour Department. Mantralaya, Mumbai 400 032. Government Resolution No. NCP-1099/P.No.319/Urja-7. Dated 9th July, 1999 (Marathi G.R.)

UNOFFICIAL DRAFT ENGLISH TRANSLATION OF WIND POLICY 2004. Government of Maharashtra. Industries, Energy and Labor Department. Resolution No. Pawan 2004/P. No. 1274/Urja – 7 Mantralaya, Mumbai – 400 032. Date: February 26, 2004

Sri Lanka

Sri Lanka has a FIT program, established by law under the Sri Lanka Sustainable Energy Authority Act, No. 35 of 2007, covering solar, geothermal, biomass, hydro, and wind energy.

Summary

Following Policy Directions for the Power Sector announced by the Ministry of Irrigation and Power in August 1997, the Ceylon Electricity Board has developed Guidelines for small hydropower plants, whereby the electricity produced can be sold to the Board under a standardized Small Power Purchase Agreement. In October 2006, Sri Lanka declared its National Energy Policy and Strategies.

Under the new National Energy Policy and Strategies, a target of at least 10% of electricity supplied to the grid from "non-conventional renewable energy" (NCRE) by 2015 has been set.

The Policy states that NCRE resources will be promoted by providing a level playing field for developers to compete through transparent procurement processes. Necessary incentives will be provided and access to green funding, including the

Clean Development Mechanism, will be facilitated to develop these resources, even if their economic viability is marginal.

In 2007, the Energy Conservation Fund for and behalf of the Ministry of Power and Energy set out the tariff structure for the purchase of energy. This is presently under revision. The responsibility of regulating tariffs related to electricity undertakings has been vested in the Public Utilities Commission of Sri Lanka (PUCSL) under the Electricity Reform Act No. 28 of 2002.

In October 2007, the Sri Lanka Sustainable Energy Authority Act, No. 35 of 2007 came into effect. A primary objective of the Sustainable Energy Authority Act is the development of 'renewable energy resources' defined as "sources of kinetic or thermal energy stemming from either solar or geothermal activity, which can be harnessed within the territory of the Republic of Sri Lanka, without affecting the ability of the future generations to harness it for their use" including "biomass energy, hydro energy, solar energy and wind energy."

Read an analysis of the new Sri Lankan Policy and Sustainable Energy Authority Act.

Indonesia

The current law is Energi, Undang-Undang Repulik Indonesia (Nomor 30 Tahun 2007)

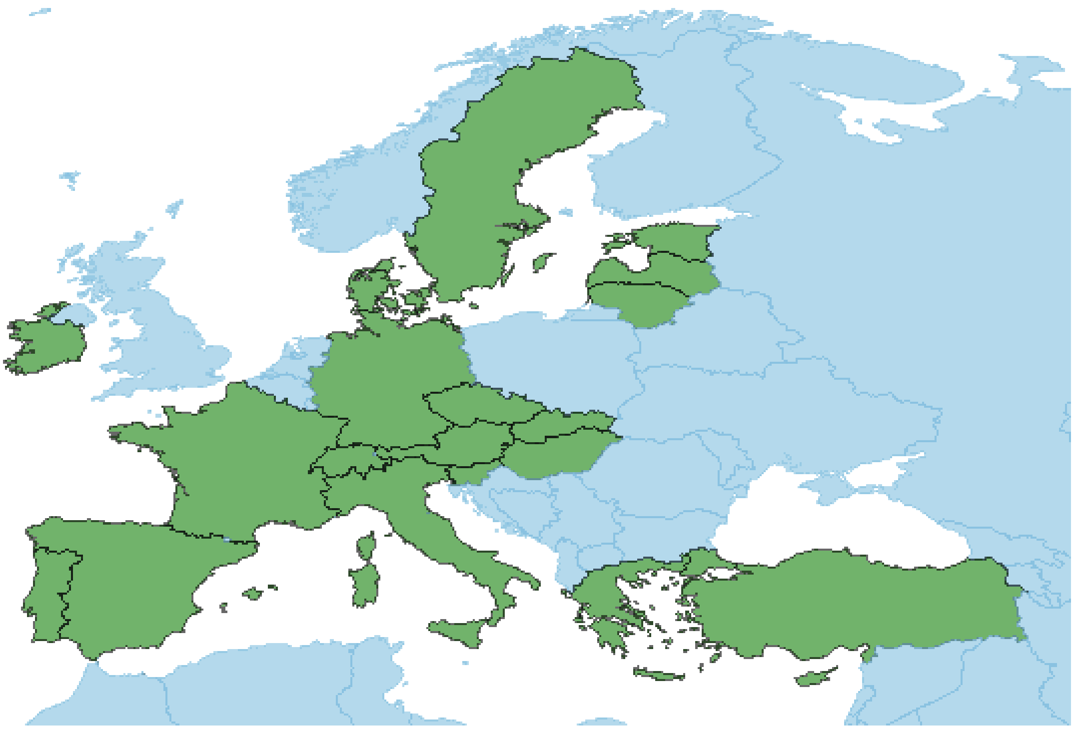
Summary

See also annex 12 and chapter 7.3.

Nepal

Nepal has not been taken into account in this anthology. But it has been detailed described in chapter 7.2.

Europe



Austria

Austria has a FIT law.

Austria enacted the Ökostromgesetz in 2002, which was revised in 2006. Ökostromgesetz, BGB1. I Nr. 149/2002, idF des BG BGB1. I Nr. 105/2006. You can read an English translation of the 2002 Ökostromgesetz (Green Electricity Act, Gazette I, no. 149/2002), but this does not include later revisions.

Summary

Austria's Green Electricity Act establishes the "eco-electricity procurement entity" (http://www.oem-ag.at/), which contracts individually with the renewable energy plant operators and pays for the electricity according to the specified feed-in-tariffs. The grid operators only have to certify the amount of electricity fed into the grid by the operators. The GEA then obliges the Electricity Traders (i.e. distributers, those companies which contract with end-users including industry) to buy from the procurement entity the renewable electricity to a fixed price, which is lower than the feed-in price (€ 10,33 for renewable electricity except hydro, 6, 47 for small hydro (≤10MW), (§ 19.1, 22b.2 and 3.). This price is set by the Energy Control Commissionthrough Regulations. The Energy Control Commission is a private body set to oversee the liberalised energy market, established by the General Electricity Act.

The difference between the feed-in tariff and the purchasing price for the electricity traders is borne by a fee paid by all consumers ("Zählpunktpauschale"). The maximum support level for renewable energy electricity is fixed on 17 Mio

€/year from 2007-2011, with waste/biomass 30%, biogas 30%, wind 30% and PV and the rest 10% (§§21a, 21b). This means that the purchasing entity is not entitled to buy renewable electricity for the feed in tariff if that annual budget is exceeded.

EC review and assessment

Read a summary of the European Commission's 2005 review of Austria's renewable electricity policies and of its 2007 assessment of Austria's progress in meeting the target set out in Directive 2001/77/EC.

Cyprus

Cyprus has a FIT law.

The main law is the Promotion and Encouragement of the Utilisation of Renewable Energy Sources and the Energy Conservation Law (as amended) (2007) (Greek).

Summary

The current tariffs can be found on the Cyprus Institute of Energy web site at: http://www.cie.org.cy/ananeosimeseng.htm. Choose the "Current Status of RES in Cyprus" presentation.

EC review and assessment

Read a summary of the European Commission's 2005 review of Cyprus's renewable electricity policies and of its 2007 assessment of Cyprus's progress in meeting the target set out in Directive 2001/77/EC.

Czech Republic

We do not currently have information about whether the Czech Republic's energy law is a FIT law. We would be happy to hear from Czech lawyers about the current law.

Current Czech energy laws include, the Act on Promotion of Use of Renewable Sources Law No. 180/2005 (English) [or in(Czech)], Law No. 475/2005 (Czech), and Price Regulations for 2007 (Czech).

Summary

There currently is no summary of this law.

EC review and assessment

Read a summary of the European Commission's 2005 review of the Czech Republic's renewable electricity policies and of its 2007 assessment of the Czech Republic's progress in meeting the target set out in Directive 2001/77/EC.

Denmark

Denmark has a FIT law.

The main law can be found in the Consolidation of the Act on Electricity Supply, Law No. 286/2005 (unofficial English translation).

Summary

There currently is no summary of this law. If you are a lawyer from Denmark, and interested in submitting a summary, we would be happy to hear form you.Contact us

EC review and assessment

Read a summary of the European Commission's 2005 review of Denmark's renewable electricity policies and of its 2007 assessment of Denmark's progress in meeting the target set out in Directive 2001/77/EC.

More information

Danish Energy Authority -- http://www.ens.dk/sw27999.asp

Estonia

Estonia has a FIT law.

The main law is the ELEKTRITURUSEADUS (Electricity Market Act) enacted on 11 February 2003. (English) (Estonian)

Summary

There currently is no summary of this program.

EC review and assessment

Read a summary of the European Commission's 2005 review of Estonia's renewable electricity policies and of its 2007 assessment of Estonia's progress in meeting the target set out in Directive 2001/77/EC.

France

France has a FIT law.

The primary law is Décret relatif aux conditions d'achat de l'électricité produite par des producteurs bénéficiant de l'obligation d'achat (Décret n°2001-410 du 10 mai 2001) (Decree on the conditions for purchase of electricity produced by producers benefiting from the obligation of purchase (Law No. 2001-410 of 10 May 2001)).

Other important laws include:

Loi No. 2005-781 (2005)

Arrêté du 10 juillet 2006 fixant les conditions d'achat de l'électricité produite par les installations qui valorisent le biogaz

Arrêté du 10 juillet 2006 fixant les conditions d'achat de l'électricité produite par les installations utilisant l'énergie mécanique du vent telles que visées au 2o de l'article 2 du décret no 2000-1196 du 6 décembre 2000

Arrêté du 10 juillet 2006 fixant les conditions d'achat de l'électricité produite par les installations utilisant l'énergie des nappes aquifères ou des roches souterraines telles que visées au 6o de l'article 2 du décret no 2000-1196 du 6 décembre 2000

Arrêté du 1er mars 2007 fixant les conditions d'achat de l'électricité produite par les installations utilisant l'énergie hydraulique des lacs, cours d'eau et mers, telles que visées au 1° de l'article 2 du décret n° 2000-1196 du 6 décembre 2000

Summary

France's 2001 law applies to energy produced from PV, hydro, biomass, sewage and landfill gas, municipal solid waste, geothermal, on- and off-shore wind, and CHP. The tariffs are based on the type of technology used and, in one instance, also on the region where the technology is located.

France's 2001 law applies to energy produced from hydro, biomass, sewage and landfill gas, municipal solid waste, geothermal, on- and off-shore wind, and CHP. The tariffs are based on the type of technology used.

EC review and assessment

Read a summary of the European Commission's 2005 review of France's renewable electricity policies and of its 2007 assessment of France's progress in meeting the target set out in Directive 2001/77/EC.

More information

"France - Renewable Energy Fact Sheet"

http://ec.europa.eu/energy/energy_policy/doc/factsheets/renewables/renewables_fr_en.pdf.

Paul Gipe, "France Implements New Renewable Tariffs for Solar, Wind, and Biogas"

http://www.wind-works.org/FeedLaws/France/FranceImplementsNewRenewableTariffsforSolarWindandBiogas.html.

Germany

Germany has a FIT law. This feed-in law has undergone continuous updating, reflecting changing conditions, objectives, and technology characteristics and costs, first in 1994, and then in 1998, 2000, and 2004.

The law is the Renewable Energy Sources Act 2004, amended in 2006 (Gesetz für den Vorrang Erneuerbarer Energien, EEG). It was preceded by the Electricity Fed-in Act 1990, and the Renewable Energy Act 2000.

Summary

The purposes of the German law are to facilitate sustainable development of energy supply, in particular to protect the climate and wider environment; to reduce energy supply costs to the national economy; to contribute to avoiding conflicts over fossil fuels; and to promote the further development of technologies for the generation of electricity from renewable energy sources. The law is intended to contribute to increasing renewable energy sources in power supply to at least 12.5% by 2010 and at least 20% by 2020.

Under the law, grid operators are obliged to immediately and priority connect eligible renewable energy (and mine gas) plants to the grid, and as a priority to purchase and transmit electricity from these plants, generally for 20 years, regardless of grid capacity. The tariff (or price) paid for the electricity is set on a technology-specific basis, varying by size, and reducing automatically by 1-6.5% annually for new plants coming into the system. These obligations operate by law, and are not conditional on conclusion of a contract.

EC review and assessment

Read a summary of the European Commission's 2005 review of Germany's renewable electricity policies and of its 2007 assessment of Germany's progress in meeting the target set out in Directive 2001/77/EC.

Legal analysis

Read a legal analysis of the German law.

More information

Germany is a member of the international Feed-in Cooperation

Greece

A primary renewable energy law in Greece is Law 3468 - Electricity production from RES & high-efficiency cogeneration & other provisions (2006) (English).

We do not currently have information about whether Greece's energy law is a FIT law.

Summary

There currently is no summary of these laws.

EC review and assessment

Read a summary of the European Commission's 2005 review of Greece's renewable electricity policies and of its 2007 assessment of Greece's progress in meeting the target set out in Directive 2001/77/EC.

Hungary

Hungary has a FIT law.

The program is mandated in Act CX of 2001. Article 5(b) of this law states: "The Minister of Transport and Economic Affairs . . . shall define the rules of feed-in obligation of electricity generated from renewable energy sources and from waste as well as electricity co-generated or produced in any other way specified by law, and establish, acting in agreement with the Minister of Finance, the order of subsidizing electricity generated in any of the above-specified manners." The primary decree implementing this law is the Decree of the Minister of Economy and Transport on the rules of feeding in electricity falling under feed-in obligation and setting of its prices (GKM) No. 56/2002 (29.12), as amended by Decree of Minister of Economy and Transport No. 78/2005 (07.10).

Summary

There currently is no summary of these laws.

EC review and assessment

Read a summary of the European Commission's 2005 review of Hungary's renewable electricity policies and of its 2007 assessment of Hungary's progress in meeting the target set out in Directive 2001/77/EC.

Ireland

Ireland has a FIT program. The program is set out in the Renewable Energy Feed in Tarriff (RE-FIT – 2006) - A Competition for Electricity Generation from Biomass, Hydro and Wind.

Summary

In 2006, the Minister for Communications, Marine and Natural Resources initiated a "Competition" for the promotion of renewable energy development in Ireland. The Competition was initiated to help Ireland comply with EU Directive 2001/77/EC. Under the Competition, any licensed electricity supplier (an entity that buys power from electricity generators and supplies it to others) that enters into a Power Purchase Agreement (PPA) with a qualified renewable energy generating plant that is a successful REFIT applicant under this competition will receive a compensation payment.

EC review and assessment

Read a summary of the European Commission's 2005 review of Ireland's renewable electricity policies and of its 2007 assessment of Ireland's progress in meeting the target set out in Directive 2001/77/EC.

Israel

Israel does not have a FIT program.

Summary

On August 6, 1998, the Government of Israel approved a decision of the Ministerial Committee for the Environment and Hazardous materials: "To Act to promote the development of technologies for the efficient exploitation of alternative energies through the reduction of dependence on imported fuels and to reduce environmental pollution". In order to apply this decision, an inter-ministerial task force was established to propose projects in the area and to recommend measures to integrate investors from Israel and abroad in alternative energy projects. On the 4th of November, 2002, the government adopted a decision that has emerged as the primary decision in the area of alternative energy production.

The two main elements of the decision are:

1) The Establishment and operation of electrical facilities and power stations for the production of electricity through renewable energies should be encouraged by private electricity producers as well as the Israel Electric Company; and
2) Beginning in the year 2007, 2% of the country's electricity must be provided to consumers by renewable electrical facilities. This rate will increase by one percent every six years, such that by the 2016, electricity will be produced by the said facilities at a rate of 5% of the overall electricity provided to consumers.

Italy

Italy has at least a partial FIT program created by Decree.

The two main Decrees are:

Decree No 387 of 29 December 2003--Implementation of Directive No 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market. (English)

Decree of 19 February 2007 -- Criteria and arrangements to encourage the production of electrical energy by means of solar photovoltaic conversion, implementing article 7 of the legislative decree of 29 December 2003, No 387. (English)

Summary

There currently is no summary of these laws.

EC review and assessment

Read a summary of the European Commission's 2005 review of Italy's renewable electricity policies and of its 2007 assessment of Italy's progress in meeting the target set out in Directive 2001/77/EC.

Latvia

Latvia has no FIT program.

Summary

There currently is no summary of these laws.

EC review and assessment

Read a summary of the European Commission's 2005 review of Latvia's renewable electricity policies and of its 2007 assessment of Latvia's progress in meeting the target set out in Directive 2001/77/EC.

Legal analysis

There currently is no legal analysis of this law.

Lithuania

Lithuania has a FIT program defined by law, the Law on Electricity, No. IX-884, 16 May 2002. (English).

Summary

The law states that the National Control Commission for Prices and Energy shall set the prices for electricity produced from renewable sources.

EC review and assessment

Read a summary of the European Commission's 2005 review of Lithuania's renewable electricity policies and of its 2007 assessment of Lithuania's progress in meeting the target set out in Directive 2001/77/EC.

Portugal

Portugal has a FIT law.

According to the International Energy Agency web site, Decree Law 33- A/2005 "establishes the way to calculate the feed in tariffs for Renewables in Portugal and establishes the validity time for these tariffs."

Summary

There currently is no summary of this program.

EC review and assessment

Read a summary of the European Commission's 2005 review of Portugal's renewable electricity policies and of its 2007 assessment of Portugal's progress in meeting the target set out in Directive 2001/77/EC.

Legal analysis

There currently is no legal analysis of this law.

Slovenia

Slovenia's laws are available on the International Feed-in Cooperation web site at: http://www.feed-in-cooperation.org/content/view/42/59

Summary

There currently is no summary of the laws from the Slovenia.

EC review and assessment

Read a summary of the European Commission's 2005 review of Slovenia's renewable electricity policies and of its 2007 assessment of Slovenia's progress in meeting the target set out in Directive 2001/77/EC.

Slovakia

Feed-in-Tariffs for Green Electricity were issued 2006. In June 2005, the Slovak Regulator has issued the feed-in-tariffs for Electricity from Renewable Energy Sources and CHP for the year 2006. This latest decree brings about considerably higher tariffs, as compared to the current regulation. For example, the tariff for electricity from newly installed wind power plants put into operation after January 1st, 2005, is fixed with 2,800 Slovak Crowns per MWh (about 72 Euro). These tariffs are set by the Regulatory Office for one year. A complete table with the tariffs is now online on enerCEE:

www.energyagency.at/enercee/sk/supplybycarrier.htm#res

Spain

Spain has a FIT law.

The main laws are Real Decreto 661/2007 de 25 de mayo, Real Decreto 1436/2002 from 27 December 2002, and Real Decreto 436/2004 (Establishing the Methodology for the Updating and Systematisation of the Legal and Economic Regime for Electric Power Production Legislation Development of the Spanish Electric Power Act. Vol. 8 (Spanish) (English).

Summary

The basic Spanish legal framework for promoting electricity generated from renewable resources was adopted on November 27, 1997 through the adoption of the Electricity Sector Act (Act 54/1997), which came into force on November 29, 1997. This Act governs generation, transmission, distribution, and sale of electricity. The Act sets out both an ordinary regime and a special regime to govern generation of electricity from renewable resources.

Royal Decree 661/2007, of May 25, regulates electricity generation from renewable sources as a special regime. The Decree allows the producer to choose between selling the energy to the distributor in return for a specified flat tariff for all the scheduling periods, or selling it directly on the day-ahead market or the futures market, or through a bilateral contract.

EC review and assessment

Read a summary of the European Commission's 2005 review of Spain's renewable electricity policies and of its 2007 assessment of Spain's progress in meeting the target set out in Directive 2001/77/EC.

Legal analysis

Read an analysis of the Spanish laws.

Switzerland

Switzerland has a FIT law.

The main law is the Federal Energy Law (Energiegesetz vom 26. Juni 1998 (EnG)).

Summary

The Federal Energy Law obliges electricity companies to buy electricity from renewable sources produced by independent producers at a fixed rate of CHF 0.15 in the annual average. The power limit (for hydropower plants only) has been set at 1 MW.

Turkey

Turkey has a FIT program established by law, the Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy, Law No. 5346, enacted in 2005.

Summary

The law mainly supports wind power by setting a purchase guarantee of the average whole-selling electricity price (some 5 ct/kWh) for a period of 7 years for electricity generated from renewable energies. Grid operators are obliged to provide access to the grid for renewable energy generators.

Table 2 of the Global Status Report on Renewables 2007 (www.ren21.net) illustrates that at the moment only Uganda has started with a concrete feed-in policy for any renewable energy resources in Tropical Africa:

Table 2. Renewable Energy Promotion Policies

Country	Feed-in tariff	Renewable portfolio standard	Capital subsidies, grants, or rebates	Investment or other tax credits	Sales tax, energy tax, excise tax, or VAT reduction	Tradable renewable energy certificates	Energy production payments or tax credits	Net metering	Public investment, loans, or financing	Public competitive bidding
Developed and transition countries										
Australia		✓	✓			✓			✓	
Austria	✓		✓	✓		✓			✓	
Belgium		✓	✓		✓	✓		✓		
Canada	(*)	(*)	✓	✓	✓			(*)	✓	(*)
Croatia	✓			✓					✓	
Cyprus	✓		✓							
Czech Republic	✓		✓	✓	✓	✓		✓		
Denmark	✓				✓	✓		✓	✓	✓
Estonia	✓				✓					
Finland			✓		✓	✓	✓			
France	✓		✓	✓	✓	✓			✓	✓
Germany	✓		✓	✓	✓				✓	
Greece	✓		✓	✓						
Hungary	✓				✓	✓			✓	
Ireland	✓		✓	✓		✓				✓
Italy	✓	✓	✓	✓		✓		✓		
Israel	✓									
Japan	(*)	✓	✓			✓		✓	✓	
Korea	✓		✓	✓	✓				✓	
Latvia	✓								✓	✓
Lithuania	✓		✓	✓					✓	
Luxembourg	✓		✓	✓						
Malta	✓				✓					
Netherlands	✓		✓	✓		✓	✓			
New Zealand			✓						✓	
Norway			✓	✓		✓				✓
Poland		✓	✓		✓				✓	✓
Portugal	✓		✓	✓	✓					
Romania					✓					
Russia			✓			✓				
Slovak Republic	✓			✓					✓	
Slovenia	✓								✓	
Spain	✓		✓	✓					✓	
Sweden		✓	✓	✓	✓	✓	✓			
Switzerland	✓									
United Kingdom		✓	✓		✓	✓				
United States	(*)	(*)	✓	✓	(*)	(*)	✓	(*)	(*)	(*)

Table 2. *continued*

Country	Feed-in tariff	Renewable portfolio standard	Capital subsidies, grants, or rebates	Investment excise, or other tax credits	Sales tax, energy tax, or VAT reduction	Tradable renewable energy certificates	Energy production payments or tax credits	Net metering	Public investment, loans, or financing	Public competitive bidding
Developing countries										
Algeria	✓			✓	✓	✓				
Argentina	✓		✓	(*)	✓		✓			
Brazil	✓								✓	✓
Cambodia			✓							
Chile			✓							
China	✓		✓	✓	✓				✓	✓
Costa Rica	✓									
Ecuador	✓			✓						
Guatemala				✓	✓					
Honduras				✓	✓					
India	(*)	(*)	✓	✓	✓		✓		✓	✓
Indonesia	✓									
Mexico				✓				✓		
Morocco				✓						
Nicaragua	✓			✓	✓					
Panama							✓			
Philippines			✓	✓	✓				✓	
South Africa			✓							
Sri Lanka	✓									
Thailand	✓		✓					✓	✓	
Tunisia			✓	✓						
Turkey	✓		✓							
Uganda	✓								✓	

Note: Entries with an asterisk (*) mean that some states/provinces within these countries have state/province-level policies but there is no national-level policy. Only enacted policies are included in table; however, for some policies shown, implementing regulations may not yet be developed or effective, leading to lack of implementation or impacts. Policies known to be discontinued have been omitted. Many feed-in policies are limited in scope or technology. Some policies shown may apply to other markets beside power generation, for example solar hot water and biofuels. *Source:* All available policy references, including the IEA online Global Renewable Energy Policies and Measures database and submissions from report contributors.

Exact present tariffs for feed-in systems and quota systems in European countries can be found in Annex 6.

Different policies for promoting renewable energy resources are presented in Annexes 9 and 10

5. The German example[4]

5.1 Introduction

The German energy supply is largely covered by fossil and nuclear fuels. 15 years before renewable energy technologies (RET) only covere some 1 % of the primary energy demand.

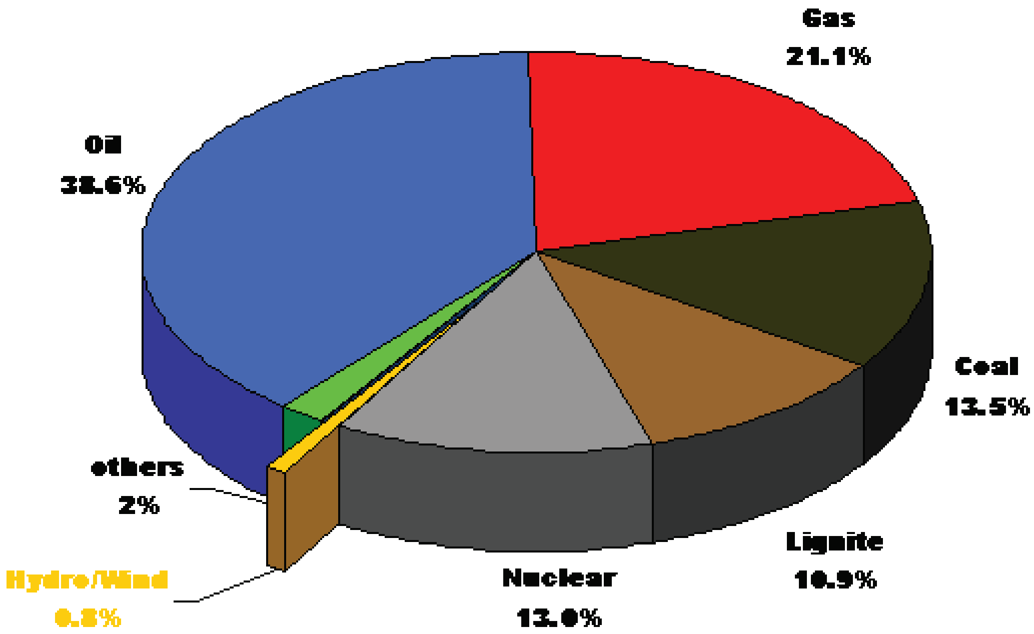


Figure 1: *Primary energy demand in Germany in 2000 (DIW 2001)*

German electricity generation is mainly based on nuclear power, coal and lignite. In 1990 (i.e. at the time when the first larger market introduction measures started) large hydro power plants were the only RET widely used, contributed

[4] Widely after: Renewable Energy Policy in Germany

only with 4 % to the total generation. The electricity supply industry was a monopolised industry until 1998. That meant, that the electricity customers did not have the freedom to choose their supplier, but only one supplier was active in every region.

Due to a whole bundle of support measures with a remuneration regulation in the centre, Germany has seen a rapid growth of RET (mainly wind power generation) in the past decade. From 62 MW in 1990, the overall installed capacity of wind power has increased to nearly 6,117 MW by end of 2000, which means that the installed capacity increased by an average 50 % between 1991 and 2000. In spite of its rather limited wind resources Germany has the highest installed wind capacity world-wide. Wind power plants have generated 1.6 % of Germany's total net electricity generation in 2000, and this share is still increasing. At the same time, this rapid growth also triggered the technological development of wind power. The average size of new power plants could be increased from 170 kW in 1992 to almost 1 MW in 1999. New players (Independent Power Producers) could be established in the power market fostering the further development of these new decentralised technologies.

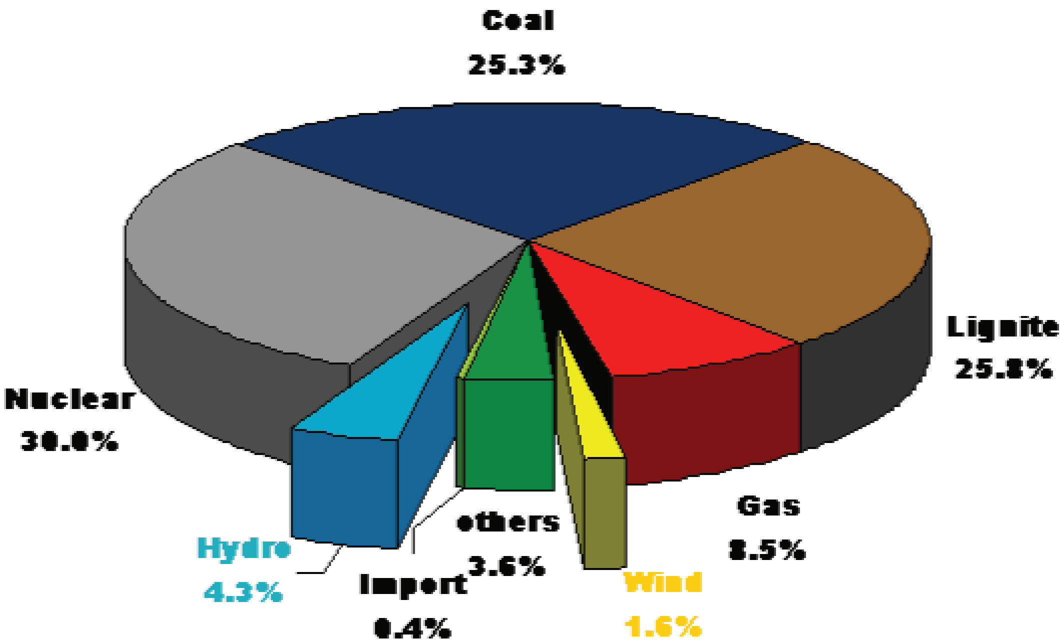


Figure 2: *Gross electricity demand in Germany in 2000 (DIW 2001)*

The potential for large hydro power plants is almost totally exploited. Moreover, environmental regulations for the energetic use of water resources are very strict in Germany in order to protect the few remaining natural flows from human impacts. In terms of total installed power, hydro power has therefore not grown significantly in the last ten years. However, the number of power plants have been increased by 20 % since 1990 exploiting especially abandoned hydro power resources on smaller flows.

Biomass technologies could not profit from the remuneration scheme to the same extent as wind power. The remuneration, according to the Law, has not been sufficient to motivate investors to overcome the hindrances connected with the realisation of biomass power plants. The energetic use of biomass is most favourable in combined heat and power plants (CHP). To supply the generated heat, a district heating system is needed in many cases causing additional obstacles for realisation. Organising the supply of appropriate bio fuels is a rather complex process. Moreover, there is a wide range of different bio fuels, conversation technologies and applications hindering the standardisation of projects.

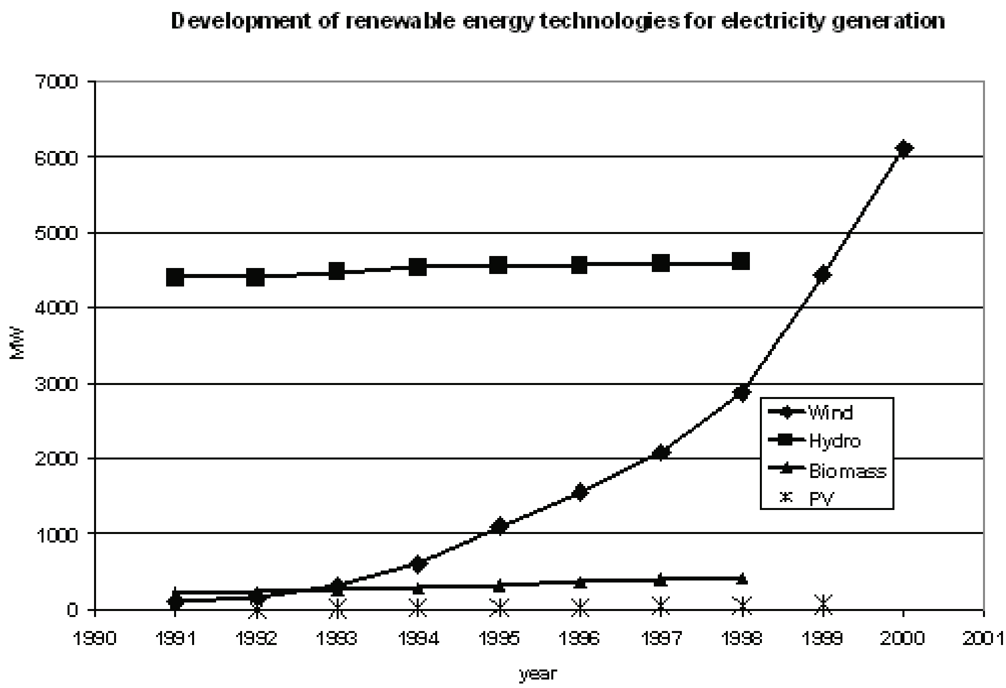


Figure 3: *Development of renewable energy technologies for electricity generation in Germany over the past decade*

Looking at the present generation costs of photovoltaic power plants, it is evident that the remuneration as it was fixed in the original Electricity-Feed-In-Law was not sufficient for establishing this technology in the electricity market. Other instruments like the "1000-roof-programme" and lately the "100.000-roof programme" give high investment subsidies to owners of photovoltaic power plants making their operation in combination with a yet higher remuneration economically? feasible.

Around 25.000 new jobs have been created solely in the German wind power industry. Annual turnover was 2 billion € in 1999. Almost 20 % of the wind turbines manufactured in Germany are exported.

The German government is aiming to double the share of RET in the electricity supply by 2010. This goal translates e.g. in 15 TW of wind power by that time.

5.2. Support of RET in the Electricity Sector

Since the two energy price crises in the seventies, a lot of efforts have been made in Germany in the research and development of RET. In the mid eighties, a lot of different technologies were feasible for market introduction. Due to the drop of energy prices, however, these technologies were often not cost competitive thus suffering from a lack of application. Moreover, the then monopolised electricity supply industry had built up surplus capacities in conventional generation technologies and showed little interest in installing new environmentally sound power plants fuelled by renewable energies. Additionally, the traditional electricity supply industry has very much the economies of scale in mind, thus preferring large power plants to small decentralised units like many renewable energy applications are. Clear and fair rules for access to the public grid did not exist. Due to this situation, the independent power producers could not achieve a reasonable price for their generated electricity either.

5.2.1. The Feed-In Law - a Real Success Story

The central policy to foster the dissemination of renewable energy systems for electricity generation in Germany is the Electricity Feed-In Law (EFL). The Parliament introduced the EFL in 1991 supported by a large coalition of all parties. This law ensured grid access for electricity generated with hydro power, biomass, biogas, wind power or solar radiation.

Moreover, it obliged the electricity supply company operating the public grid to pay premium prices for the electricity fed in from these power plants. As figure 3 depicts, no money from public budgets was involved but the burden from the Act was exclusively born. by electricity suppliers and their customers. Thus, the remuneration is not rated as a subsidy.

The premiums in the EFL were calculated annually as a percentage of the mean specific revenues for all electricity sold via the public electricity grid in the previous year. This was felt to be the appropriate method to set the societal value of electricity from RET. The remuneration varied according to the technology and the plant size. Wind power plants and solar power plants got the highest remuneration with 90 % of the mean specific revenues, followed by small hydro, biomass and biogas power plants smaller than 500 kW with 75 %, the latter raised to 80 % some years later.

Hydro, biomass and biogas power plants larger than 500 kW, but smaller than 5 MW received 65 % of the mean specific revenues. Plants larger than 5 MW were not covered by this Law. Thus, the predominant share of generation facilities based on renewable energy sources that existed at the time of introduction of the Feed-In-Law was excluded. This way it was ensured that mainly new facilities gained advantage of the Law.

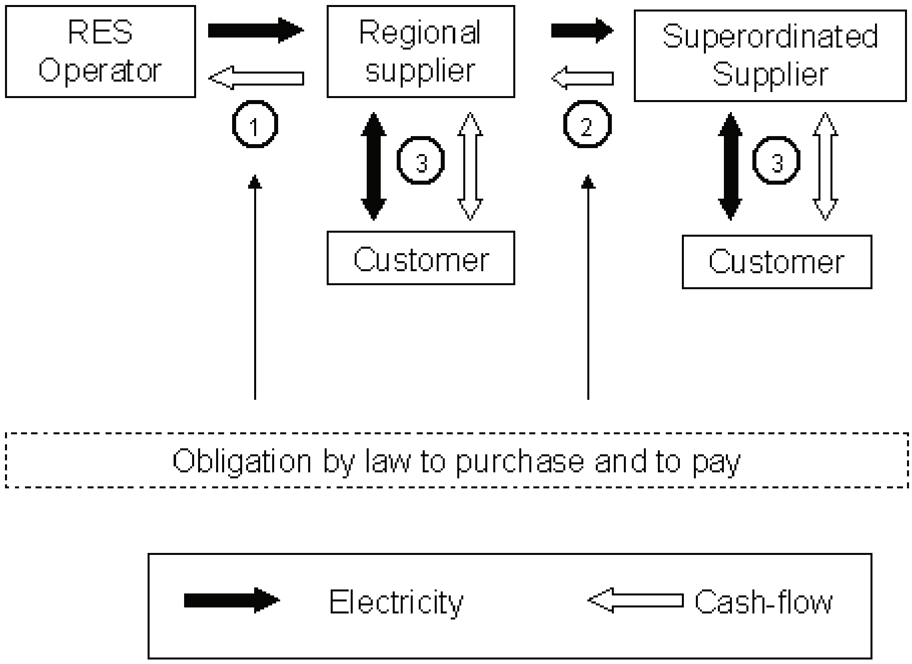


Figure 4: *Scheme of the German electricity feed-in law*

Power plant technology	(a)	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	%	cents €/kWh									
Hydro & biomass < 500 kW	75/80	7,08	7,05	7,06	7,21	7,85	7,82	7,80	7,63	7,51	7,33
Hydro & biomass 500 - 5 MW	65	6,13	6,10	6,12	6,25	6,38	6,36	6,33	6,20	6,10	5,96
Wind & Solar	90	8,49	8,45	8,47	8,66	8,84	8,80	8,77	8,58	8,45	8,25

Table 1: *Development of premium prices according to the German feed-in law (cents* □*/kWh)*

- *Percentage of specific mean annually revenues*

  Looking at the deployment of wind power plants, the EFL can be assessed as a very successful support mechanism. However, other technologies like biomass, biogas or photovoltaics have not experienced a comparable development in the past decade. Additionally, a number of problems have occurred since the Law was established in 1991. Mainly, the electricity supply industry violently attacked the EFL. They criticised that the premium tariffs fixed by law does not reflect the value of the generated electricity. From their point of view there was no sufficient competition to induce cost reductions. Since most of the power plants favoured by the Law i.e. mostly wind power plants are situated in the north of Germany, the to-

tal burden of costs were higher for electricity customers in the north than for southern customers. With the liberalisation of the electricity markets in 1998 the question of a competition neutral compensation of costs became even more important. As another effect of liberalisation, the average prices along with the average revenues for electricity in Germany dropped significantly. Due to the calculation method of the premium prices, these premium prices dropped, too. Since operators of the renewable energy plants calculated with stable remuneration over the lifetime of the power plants - which was reasonable under a monopoly situation - the drop of premium prices caused severe financial problems to the operators. Since generation costs of wind power plants depends very much on the wind speed at the specific sites, the remuneration was often insufficient for plants on inland sites whereas plants on the coastal sites received extra profits.

Taking the crucial points and the new requirements occurring from the liberalisation into account, the EFL has been renewed and extended to the Renewable-Energy-Act (REA) in March 2000. The most important changes are summarised in figure 5. Some of the changes are described in more detail below.

Figure 5: *Summary of the changes in the Renewable Energy Act of 2000:*

- The level of the remuneration is fixed on the basis of the electricity generation costs of the individual technologies. Photovoltaic appliances built before 2002 will receive 0.99 DEM[5]/kWh, for small hydro power 0.15 DEM/kWh, for geothermal power between 0.14 and 0.175 DEM/kWh and for electricity generated with biomass between 0.17 and 0.20 DEM/kWh.
- Remuneration for wind power plants takes the specific wind speed at the individual site into account. At an average site, wind power is remunerated in average with 0.164 DEM/kWh over a lifetime of 20 years.
- The remuneration rates will be lowered annually for new installation by 5 % (photovoltaic) or 1.5 % (all other technologies), respectively. This measure should induce further cost reductions.
- Also utilities may now take full advantage of the law.
- Costs and electricity are equally distributed on all electricity suppliers nation-wide.
- It is legally fixed that plant operators have to pay the grid connection, but the grid operator has to bear the grid enforcement if necessary.

[5] Convertion DEM > €: 1,95583 DEM = 1 EUR

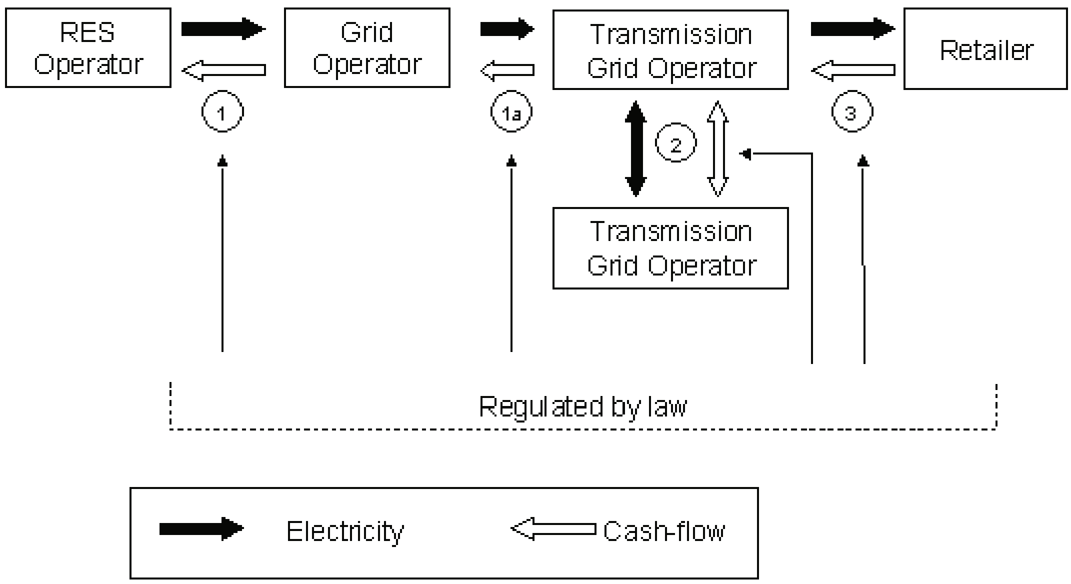


Figure 6: *Scheme of the German renewable energy act*

The scope is widened to geothermal power plants and larger biomass plants. As stated in the REA, it aims to achieve a sustainable development of the electricity supply system. A major complaint on the original EFL was the lack of an efficient mechanism to distribute the burden regionally equal. This led to a situation where utilities and their customers in northern Germany with the majority of wind power installations under the Law had to pay a considerable higher share of the costs than the southern companies and their customers. The REA solves this problem by requiring electricity supplier to have the same share of RET-electricity in its fuel mix. Thus, not only the costs but also the benefits in form of the generated electricity are shared equally. Through this design there is no need to calculate the "real" value of the electricity fed in. On the other hand the physical distribution of the RET- electricity among all suppliers causes additional costs.

Under the regulated framework which came into force at that time, the EFL concept led to a rather constant remuneration over the years giving the investors high certainty on their income flows. However, the introduction of competition led to falling mean electricity prices and thus also decreasing remuneration. Therefore, the succeeding REA introduced cost based tariffs (table 2). A RET installation will get the same specific remuneration over a period of 20 years. In each year, the remuneration for new plants are reduced by a certain factor to give incentives for cost reductions. Additionally, a board consisting of the Electricity Supply Industry, power generators, public administration and researchers are periodically reviewing the remuneration.

Technology	Size	Remuneration in 2000	Annual decreasing factor for newly installed plants
Hydro, sewage gas, landfill gas, marsh gas	**< 0.5 MW**	**0.077 €/kWh**	-
	0.5 – 5 MW	**0.066 €/kWh**	
Biomass	**< 0.5 MW**	**0.102 €/kWh**	**1 %/a**
	0.5 – 5 MW	**0.092 €/kWh**	
	5 – 20 MW	**0.087 €/kWh**	
Solar	**< 5 MW [1)]**	**0.506 €/kWh**	**5 %/a**
Wind	**No limits**	**0.062 / 0,091 €/kWh [2)]**	**1.5 %/a**
Geothermal	**< 20 MW**	**0.089 €/kWh**	-
	> 20 MW	**0.072 €/kWh**	

Table 2: *Remuneration according to the Renewable Energy Act.*

non-roof installations limited to 100 kW

- *depending on specific wind conditions on site*

The EFL was mainly intended to help independent power producers. However, plants operated by the electricity supply company could receive the premium prices if they are situated outside the supply area of the individual company. The REA does not distinguish anymore on the ownership of plants: Now any plant is eligible for the remuneration from the technical point of view will be remunerated according to the Law.

With this Law and some accompanying instruments, the German government aims at doubling the share of renewable energy technologies on electricity generation from the present 5 % to 10 % by 2010. The goal is to have 12,500 MW wind power plants installed in Germany by 2010.

In a regulated electricity market as it existed in Germany until 1998, the electricity suppliers who were obliged to pay the premium prices could transfer the additional costs to the captured customers. Public budgets are not needed to finance the EFL (as well as the REA), making it very politically attractive. There has been a long discussion going on about the extent of the additional costs. This discussion mainly focussed on the question of the value of the electricity fed in. Since a market price does not exist in a regulated environment the concept of avoided costs was applied. The electricity supply industry argued that due to their fluctuating character, electricity from renewable energies does not have any capacity effect. Thus the only costs avoided are the fuel costs. Others argued that a growing number of renewable energy power plants do have capacity effects. Additionally, transmission losses can be reduced since renewable energy plants are generally smaller and more decentralised than conventional

power plants. Calculating with 5,1 cents €/kWh as reasonable mean avoided costs, the additional costs of the EFL amounted to 270 million € in 1999, which means that the price of any generated kilowatt-hour increased by merely 0,05 cents €.

5.2.2. Beyond the Renewable Energy Act

A successful market introduction policy cannot be based exclusively on one single instrument. For a fast and continuous growth a whole package of measures is needed to foster a further research and development and to establish these technologies in the legal and political framework. Favourable economic conditions help to overcome the non-economical barriers. Thus, in addition to the Feed-In-Law some supplementing regulations were established to foster the market introduction of renewable energies in the electricity sector. In the early nineties, an additional subsidy (2 cents €/kWh) was introduced for the first 250 MW of installed wind power in Germany as an aid for market introduction within the "250 MW field test programme". The 1000-roof programme gave investment grants for around 2000 photovoltaic installation. After some years of larger federal support for PV - and thus low deployment of these technology - the "100,000 roof Programme" in 1999 aiming at the installation of an additional 300 MW of PV by 2003. It provides soft loans with Interest rate reduction of max 4.5 %, 100 % coverage, 10 years loan term and first 2 years without discharge which correspond to a subsidy of 23 %. Together with the favourable remuneration according to the Renewable Energy Act this support has led to a rapid growth of PV-installations.

In addition, the federal states and municipalities launched support programmes for different technologies. The total public support for electricity generating renewable energy technologies amounted to 100 million € in 1999, not taking into account the costs of the Electricity-Feed-In-Law.

R&D for all kinds of RET has been supported throughout the eighties and nineties. A focus has been laid on PV (30 million € in 1999) and wind energy (15 million € in 1999).

A federal public bank is distributing soft loans with low interest rates (2 % points below market level) and favourable discharge conditions. The availability of capital is a very important precondition for applying renewable energies, since specific capital demand is high compared to fossil fuelled power plants. Especially small independent power producers suffer from a lack of access to inexpensive capital.

The building codes have been changed giving renewable energy technologies the same legal status as any other power generation technology. Moreover, the municipalities were forced to allocate potential sites for wind power plants in their land development plans. The requirements on such sites were legally defined.

5.2.3. Lessons Learned

The Electricity-Feed-In-Law and its successor the Renewable-Energy-Act are the central instruments in supporting renewable energy technologies for electricity generation. They assure a fair grid access and a stable minimum remuneration. Thus independent power producers could enter the electricity market with RET. Compared with other European countries having implemented renewable portfolio standards (also called quotas), European countries with minimum price standards showed a larger and faster growth of renewable energy technologies. New actors could be involved, spreading the idea of an environmentally sound electricity production in the population, which ensures a good public backing.

A minimum price standard for electricity from renewable sources as it is fixed in the EFL and its successor REA, may be implemented successfully both in regulated as well as in liberalised electricity markets. Minimum price standards may be introduced on a regional, national or international level.

German legislators from Left and Right in the 1990's arrived upon feed-in tariffs as a way to promote local and regionally produced green energy and protect it from lowball pricing by the German utility industry. A product of the collaboration between the very conservative CSU and the Greens, the original tariff was a guaranteed per kilowatt hour wholesale price to small hydroelectric plants, wind generators and solar installations. In the year 2000, the pricing formula of cost plus a reasonable profit was instituted in the first German Renewable Energy Law (EEG) to further promote the development of economies of scale in a wider range renewable technologies. The new law introduced the concept of "degression" which means that future manufacturing efficiencies are forced by reductions in the per/kWh cost each successive "class year" of generators.

The German law is considered an unqualified success for the German renewable energy industry that now employs approximately 210,000 people in a country of 82 million people. In a country without the traditional large hydroelectric resources of its more mountainous neighbors in the EU, Germany now generates 14% of its electricity from renewable sources with the goal to reach 25-30% by the year 2020.

The general agreement that a move to renewable energy is advisable has not been backed up with policies that enable effective action. Because of rapid rates of installation of renewable generators, people are looking to the example of Germany, where feed in tariffs have been most successfully established. Germany more than doubled the amount of renewably generated electricity on its grid from 2000 to 2007 (6% to 14%).

(See also Annexes 4, 4a and 4b)

German feed-in tariffs are supported by a variety of other policies including preferential finance though soft-loans for environmental-friendly technology, and R&D.[6]

Very specific for the German renewable electricity market is that almost all such plants are owned and operated by private "non-utility" companies or even individuals. Most of those companies have been set up as closed funds, raising equity from a number of "share-holders".[7] One major reason for this strong civil society participation is that utilities until the enactment of the EEG could not benefit from the feed-in tariffs. Only in recent years have major investment companies and some utilities (often locally operating city utilities) started to set up own projects, a tendency that will further evolve with the development of large-scale off-shore wind farms that need huge investment capital.

Renewable Energy Source	***Range of Performance[8]***	***Feed-in Tariff in €/MWh***				***Degression***	***Payment Duration***
Solar		Installed on buildings	Bonus for façade-	All other systems		5% (6.5% for all other systems)	20
	< 30 kW 30 kW – 100 kW > 100 kW	518 493 487	50	406			
Biomass		general	Bonus for renewable primary	CHP-Bonus	Used wood, commissioned after 29.6.2006	1.5%	20
	< 150 kW 150 – 500 kW 500 kW – 5 MW	112 96 86	60 60 40 (25 for wood)	20	38		

6 These are discussed in the IEA Global Renewable Energy Policies and Measures Database available at: http://www.iea.org/textbase/pamsdb/grcountry.aspx?country=Germany

7 Normally about 20-25% as equity with the rest financed by banks as debts (10 year credits with fixed interest rates).

8 i.e. The tariff is paid according to the capacity ranges for every individual plant. For example, for a 50 kW PV plant, the total energy yield is split into a capacity share for up to 30 kW and into a capacity share exceeding 30 kW. The final feed-in tariff will therefore be a calculated mix between the two tariffs in the list.

Renewable Energy Source		***Range of Performance***[9]	***Feed-in Tariff in €/MWh***		***Degression***	***Payment Duration***
Hydro	large (> 5 MW)	< 500 kW 500 kW – 10 MW 10 MW – 20 MW 20 MW – 50 MW	75 65 60 45		1%	15
	small (< 5 MW)	< 500 kW 500 kW – 5 MW	97 66		—	30
Geothermal		< 5 MW 5 MW – 10 MW 10 MW – 20 MW > 20 MW	150 140 90 72		1% starting in 2010	20
Wind	off-shore		for 12 years	after 12 years	2% starting in 2008	20
			91	62		
	on-shore		For at least 5 years after commissioning	Reduced payment, time depending on yield of	2%	20
			84	53		
Landfill gas, sewage gas, mining gas			General	Bonus for specific innovative technologies	1.5%	20
		< 500 kW	74	20		
		> 5 MW (only mining gas)	64			

Feed-in tariffs in Germany for renewable energy systems commissioned in 2006. Note that "Degression" refers only to the annual reduction of tariffs for newly commissioned systems.

9 The tariff is paid according to the capacity ranges for every individual plant. For example, for a 50 kW PV plant, the total energy yield is split into a capacity share for up to 30 kW and into a capacity share exceeding 30 kW. The final feed-in tariff will therefore be a calculated mix between the two tariffs in the list.

6. African Examples

6.1 Uganda

Uganda with the new "Renewable Energy Law” in 2007 has a tool to promote the Power feed of electricity from renewable energies in public electricity networks. It is part of the "Power Generation Program", for "Small Power Schemes". The key elements are a standardized Power Purchase Agreement and feed-in tariffs. The tariff currently cover only small hydro power and cogeneration, however, on the basis of further studies in principle also other sources of energy such as biomass, wind power, geothermal and solar energy may be added in the future.

The tariffs are staggered to peak, sholder- and off-peak services. Also higher tariffs may be obtained for the first time of using a new technology. At the moment costs are based on the cost-estimate for new base load hydropower plants in Uganda. For the medium term, however, they will be oriented on the marginal costs of production and the principle of avoided costs.

The law also provides for the future more targeted incentives such as direct subsidies.

The purposed law budgets the following feed-in tariff schedule for renewable energy generators of less than 20 MW (all values in US¢/kWh):

i) Hydropower

	Years 1 - 6	Years 7 - 20	Simple Weighted Average
Peak	12.0	9.00	9.90
Shoulder	6.40	5.40	5.70
Off-peak	4.00	1.50	2.25
Average	7.20	5.33	5.89

ii) Cogeneration with Bagasse

	Years 1 - 6	Years 6 - 15	Simple Weighted Average
Peak	12.00	8.00	9.60
Shoulder	6.00	4.50	5.10
Off-peak	4.10	4.00	4.04
Average	7.03	5.25	5.96

Please also pay attention to Annex 3.

6.2 Kenya

The government of Kenya recognises that other renewable energy sources (RES) including solar, wind, small hydros, biogas and municipal waste energy have potential for income and employment generation, over and above contributing to the supply and diversification of electricity generation sources. Sessional Paper No. 4 of 2004 on Energy incorporates strategies to promote the contributions of other renewable energy sources in the generation of electricity.

In Section 6.3.2 of the Sessional Paper No. 4 of 2004 on Energy the Government is committed to promote co-generation in the sugar industry and other establishments where the opportunity exists to meet a target of 300 MW by 2015 .

Section 6.4.1 (i)-(iv) of the Sessional Paper No. 4 of 2004 on Energy provides for the government to undertake pre-feasibility and feasibility studies on the potential for RES and for the packaging and dissemination of information on renewable energy sources to create investor and consumer awareness on the economic potential offered by other renewable sources of energy.

Pursuant to these policy strategies and in recognition of the potential of renewable energy sources in Kenya, the Ministry of Energy has encouraged potential IPPs to carry out feasibility studies on wind and biomass generation on the basis of which power purchase agreements with the Kenya Power and Lighting Company (KPLC) can be negotiated.

In view of the time and resources required to undertake feasibility studies, the MoE prepared a Position Paper in FY 2007/08 proposing to set Feed-in-Tariffs for electricity generated from renewable energy sources; specifically wind, biomass and small hydro in order to safeguard the investments made by the respective developers in data collection undertaking feasibility studies; and to boost the development of Renewable Energy Sources Electricity (RES-E) generation.

Feed-in Tariff for Small Hydro Power Resource Generated Electricity

For the purposes of this tariff, Small hydro power plant means the hydro based power plants whose installed capacity is greater or equal to 500kW but less than or equal to 10 MW.

An assessment of small hydro resource potential carried out by the Ministry of Energy indicates that there are suitable sites for small hydro power development in the country. Substantial investments are however needed to carry out detailed feasibility studies to establish the economic viability of the said sites for power generation.

To attract private sector capital in small hydros resource electricity generation, the Ministry of Energy hereby establishes the feed-in-tariffs (FiT) for small hydro power resource generated electricity.

A stepped fixed tariff for small hydro power generated electricity not exceeding the prices shown in the following Table below shall apply on electrical energy supplied in bulk to the grid operator at the interconnection point.

Table 2

Power Plant Effective Generation capacity (MW)	Firm Power Tariff (¢/kWh)	Non-Firm Power Tariff (¢/kWh)
< 1	12.0	10
1 – 5	10.0	8.0
5 – 10	8.0	6.0

The tariffs shall apply for 15 years from the date of the first commissioning of the small hydro power plant

The firm power tariff shall apply to the first 100MW of small hydro, firm power generating stations developed in the country.

The non-firm power tariff shall apply to the first 50MW of small hydro Non-firm power generating stations developed in the country.

The tariffs shall apply to individual small hydro power plants whose effective generation capacity does not exceed 10MW.

See also Annex 5

6.3 South Africa[10] - RENEWABLE ENERGIES PILOT PROJECT

6.3.1 OVERVIEW

As part of it's vision to promote the generation and use of renewable energy, the Nelson Mandela Bay Municipality alongside with the Nelson Mandela Metropolitan University is currently investigating on the feasibility to implement so called "small scale decentralized grid connected renewable energies" in the Municipality, and furthermore in South Africa.

- Small scale, because the systems used are sized for household needs.
- Decentralized, because the energy production is scattered amongst various households, instead of having only one large plant.
- Grid-connected, so that the household can exchange electricity with the grid.

10

– Renewable energies, because the electricity is produced from renewable sources (wind, sun…)

A typical domestic dwelling has been selected for the purpose, and a complete hybrid system comprising of solar panels, a wind turbine, battery storage and the necessary monitoring and control equipment has been installed.

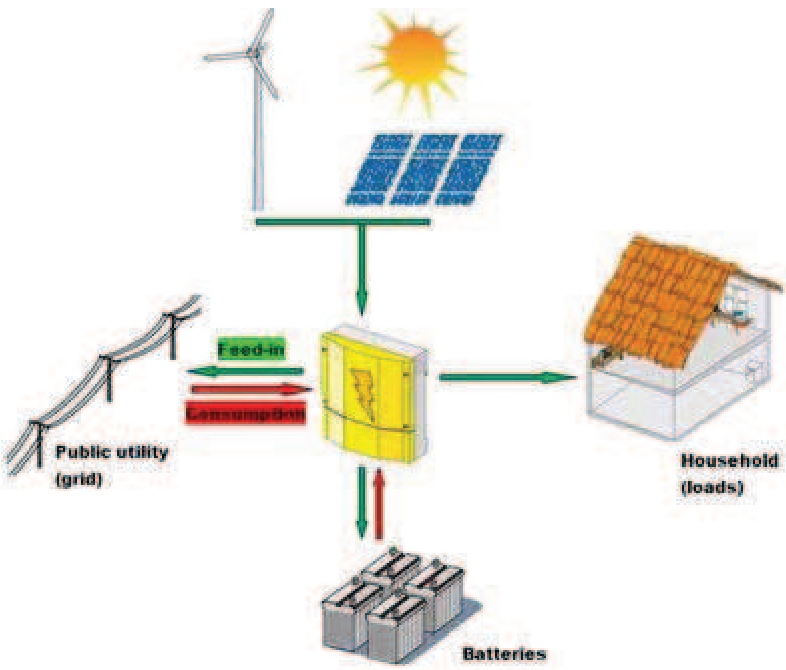
In the aim of promoting renewable energy sources and giving public exposure to the project, a wind turbine will shortly be mounted on Hobie beach's pier (on the top of the ready existing mast). The electricity produced will be used to power a set of lights at the end of the pier.

http://www.mandelametro.gov.za/Content.aspx?objID=369 - TOP

6.3.2 WHAT ARE THE MOTIVATIONS FOR SUCH PROJECT?

- Worldwide environmental considerations. The use of renewable energies contributes to slow down the process of global warming and emission of *greenhouse gases* in the atmosphere.
- Fossil fuel shortage. We are already experiencing the up rise of costs for traditional energy sources in electricity production, sooner or later these sources will no longer be economically viable and alternative solutions will have to be considered.
- Alleviate households from grid dependence. By producing their own electricity, households are no longer impacted by load shedding or tariff rise.http://www.mandelametro.gov.za/Content.aspx?objID=369 - TOP

6.3.3.DESCRIPTION



The electricity produced from the renewable sources (here solar panels and a wind turbine) is converted in a 220V/50Hz sine wave by the grid manager/inverter (yellow on the scheme) so that it can be used as the regular supply. The excess energy produced (not consumed by the household) can be "fed" into the grid through a special feed-in meter.

The batteries can be used for backup purposes when the grid is down: they can be charged at day time by the renewable sources, and provide energy at night time.

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6.3.4 PROJECT DELIVERABLE

If successful, this project will allow people to connect renewable sources of energy (e.g. wind turbines, solar panels…) to the public utility, and sell the excess energy produced (electricity which isn't consumed by the household) at a so-called "green feed-in tariff".

The scope of this green tariff is to make renewable energies affordable for everyone. Indeed, by selling back the energy into the grid at a higher price than that for consumption (currently R 0.42 per kWh), after a certain period of time the overall income generated by the electricity production is sufficient to cover the initial costs of the systems. This period of time is called "break-even" period. It varies accordingly to many factors, mainly: the feed-in tariff, the amount of energy harvested per year, the type of systems used and the initial cost of the systems.

Following, a rough illustration of the mechanisms of feed-in tariffs:

Type of systems	1kW PV + 1kW wind (hybrid)		2kW PV		3kW Wind
	Planned	Unfavourable	Planned	France	Planned
Initial cost (R)	180500	180500	170000	100000	157500
Annual energy harvest (kWh)	4288	4288	2576	2000	5500
Annual income (R)	7718.4	1800.96	4636.8	11000	9900
Feed-in tariff (R/kWh)	1.8	0.42	1.8	5.5	1.8
Break-even time (years)	**24**	**101**	**37**	**10**	**16**

From this very simplified simulation of feed-in tariffs, it is possible to see the effect of the various factors on the break-even period. As shown above with France, a high feed-in tariff (around R 5.5 per kWh produced from PV source) encourages people to invest in such forms of energy, since they are assured of breaking even after around 10 years. Since PV panels have a life expectancy of 25 years, one can understand the popularity of such systems overseas…

(See also Annex 7)

6.3.5 Other Scenario on RE in the Electricity Sector for South Africa

In the following, there will be given with some rough calculation an indication, which extent the financial burden may be originated from the support of bulk RE electricity generation. This calculation is based on some very simple assumptions.

The starting point is, that one takes the potentials of different RE technologies as given in the White Paper[11]. It’s assumed different realization rates of the potentials according to the different costs of the technologies (the lower the costs the higher the realization rate) and short term feasibility both in technical and organizational sense. 80 % of the potential biomass residues are used as well as 80 % of the wind power potential. The potential hydro power is assumed to be exploited only half due to the more lengthy realization. Five solar thermal power plants each of 100 MW are assessed to be feasible to be commissioned by 2012. Since the scenario describes exclusively grid connected power generation PV is not considered. In sum, such a RE generation port-folio would contribute to 14.6 % of the present electricity supply which translates to 26.6 TWh10. Please note, that this amount is much more as the target stated in the August version of the White Paper and relates much more to targets expressed in earlier versions of the White Paper. Additional costs amounts to € 380 million/yr by 2012. This translates to an increase of the present average electricity sales price of 0.0021 EUR/kWh sold or a relative price increase of 12 % over ten years.

	Potential		Generation Costs	Scenario		
						Additional Costs
	GW	GWh	€ct/kWh	%	GWh	M€/yr
Wind	3	6000	4.5	80%	4800	132.00
Biomass					15120	189
Bagasse	0.39	1200	3	80%	960	12.00
saw mills		7600	3	80%	6080	76.00
pulp mills		4500	3	80%	3600	45.00
energy crops						0.00
grass						0.00
manure		5600	3	80%	4480	56.00
Hydro		11000	2	50%	5500	13.75
Solarthermal		36000	6		1100	46.75
PV			80		0	0.00
Total		71900			26520	381.5

Table 1: *A simple scenario for bulk RE generation in South Africa by 2012.*

There are certain short falls of this scenario approach. First, due to a lack of transparent generation and transmission costs we relate the RE generation costs

[11] It is believed that this rated potential is largely underestimating the real potential. Take the case of wind power. With more than 4000 km of coast line and 1,2 million km² area, SA is estimated to have only 3 GW of wind potential, whereas Germany with only 1000 km coast line and 350,000 km² has already realised 10 GW of wind power by summer 2002.

to the entire average electricity price. No growth of the electricity demand is considered. No cost reductions due to e.g. technical progress with RE technologies is considered. It's not calculated mitigated external costs either. This scenario may still give an indication of the order of magnitude of costs.

Who Should be Obliged to Purchase the Electricity?

The first question to be answered when designing a Feed-In regulation is who should be obliged to purchase the electricity from RE power plants. If one assume a fully liberalised and disintegrated electricity market

1. power generators
2. transportation grid-operators
3. distribution grid-operators
4. electricity suppliers or
5. electricity consumers
6. an independent (state) agency

could be potentially obliged. Principles to be considered with the choice are

1. there should be exactly one but only one obliged party for any RE plant. Otherwise it might lead to confusion if several different entities are obliged with a certain power plant. More over, obliged parties might shift off their obligation to each other.
2. the parties to be obliged should be able to market the RE electricity. At least they should be able to forward it to entities that are able to do so.
3. the additional financial burden from the purchase of RE power should be distributed equally since it is a national target to deploy RE electricity. For instance, the additional costs electricity consumers are charged in a region with a lot of obliged RE electricity purchase should be not higher than in areas with only a few RE power plants.
4. the obliged purchase of power should not lead to a distortion of competition. This has to be considered only if the parties who finally bear the burden are in competition to each other.
5. It must be feasible to enforce the obligation.

The first two principles point very much to the sectors of the electricity industry which are monopolies. Then in any region only exactly one grid-operator exists to whom the RE generator may address. In a regulated environment that are the integrated electricity suppliers. In a liberalised market it is the grid usually which remains a regulated monopoly. An important and desirable side-effect of obliging the grid-operator is that the access to the grid is regulated simultaneously. Thus, access to the grid (often rated as the highest hurdle for independent RE generators) will be solved at the same time. It is sometimes argued that obliging the grid-operator to purchase electricity would counteract against a clear distinction between generation, distribution and trade, as it is seen as an indispensable con-

dition for liberalising electricity markets. According to this argument, grid-operators should have the exclusive task to transport and distribute electricity from the generation to the consumption but they should not own or market power. In practise however, a grid-operator needs to purchase and marketed electricity also in an entirely liberalised market to balance generation and demand in the electricity system[12]. Thus, the marketing of the RE electricity would not require additional skills which are located with the grid-operators anyway. The grid-operator might even use some of the RE power to balance the system[13].

With one national operator running a grid all over the country a surcharge on the grid-fees may be imposed on any electricity to be transported through the grid. By this, the financial burden will be distributed equally among all customers. Certain customer groups like electricity intensive industry (for reasons of international competition) or low-income households (for reasons of affordability) might be excepted from this surcharge. However, since electricity prices in SA are already among the lowest world-wide and the specific financial burden is very low it seems reasonable to abstain from such exemptions as far as possible.

In case of several different grid-operating companies operating in different regions one has to establish a balancing mechanism to keep the burden equal for all customers all over the country. This is not only desirable according to the third principle but also because commercial customers in competition might be effected differently in different grid-areas otherwise. A possible option for a balancing system would be to include the additional costs of the RE in the surcharge to be raised for the purpose of the planned National Electrification Fund anyway.

Alternatively to imposing an obligation, the state itself might purchase and marketed the RE electricity. Either an own state agency is established for this purpose or this task is handed over via a public request for proposals to a private entity. The costs could be covered via a grid-charge. Such an approach would have the advantage that the purchase of RE electricity did not interfere with any other business of the purchasing party. RE generators would clearly know to whom to address to. However, such an attempt would require additional regulations on grid-access which would be included with an obligation of grid-operators automatically. Moreover, it would contradict against privatisation of the power sector since the state would need to play a more active role on the market.

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[12] Sometimes these tasks are taken away from the grid-operator and allocated with an additional system-operator.

[13] RE technologies best controllable thus suitable for balancing the electricity grid are biomass plants and geothermal power plants.

6.4 Nigeria

Until lately, the Power Holding Company of Nigeria (PHCN) was the only entity legally permitted to produce and distribute electricity. Under the 2005 Act, independent power producers are permitted to operate, however, the legal framework for successfully implementing PPA is still evolving. The perception of significant regulatory risks by potential investors and financial institutions compound the challenges faced by potential renewable electricity investors. Moreover, guaranteed access to the grid is an important element of an investment decision to embark on grid-connected power projects. At present, a non-discriminatory open access to the national electricity grid, for renewable power, is not assured.

Therefore at the moment there are no concrete plans for a feed-in policy. But on the planning stage there are observations for a change in the future:

In the Policy Overview of the National Energy Policy, NEP, of August 2003, the overall thrust of the energy policy is stated as "optimal utilization of the nation's energy resources for sustainable development". The following are the relevant provisions of the NEP for the development of the Policy Guideline:

Hydropower

Policies

(i) The nation shall fully harness the hydropower potential available in the country for electricity generation

(ii) The nation shall pay particular attention to the development of the mini and micro hydropower schemes

(iii) The exploitation of the hydro power resources shall be done in an environmentally friendly manner

(iv) Private sector and indigenous participation in hydropower development shall be actively promoted

Objectives

(i) To increase the percentage contribution of hydro electricity to the total energy mix

(ii) To extend electricity to rural and remote areas, through the use of mini and micro hydro power schemes

(iii) To conserve non-renewable resources used in the generation of electricity

(iv) To diversify the energy resource base

(v) To ensure minimum damage to the ecosystem arising from hydropower development

(vi) To attract private investments into the hydropower sub-sector

Strategies

(i) Establishing and maintaining multilateral agreements to monitor and regulate the use of water in international rivers flowing through the country

(ii) Ensuring increased indigenous participation in the planning, design and construction of hydropower stations

(iii) Providing basic engineering infrastructure for the production of hydropower plants, equipment and accessories

(iv) Encouraging private sector, both indigenous and foreign, in the establishment and operation of hydropower plants

(v) Encouraging private sector, both indigenous and foreign, for the local production of hydropower plants and accessories

(vi) Ensuring that rural electricity boards incorporate small-scale hydropower plants in their development plans

(vii) Promoting and supporting R&D activities for the local adaptation of hydropower plant technologies

(viii) Initiating and updating data on the development of the hydro potential of our rivers and identifying all possible locations for dams

Similar policies have been formulated for the solar, biomass and wind sector.

For a **Feed-in Policy** in the grid the following observations have been formulated:

The Federal Government shall establish stable and long-term favourable pricing mechanisms and ensure unhindered access to the grid. Grid operators must guarantee the purchase and transmission of all available electricity from renewable electricity producers. While renewable electricity plant owners bear the cost of connection, grid operators must ensure the necessary system upgrade. All upgrade costs must be declared to ensure the necessary transparency.

The following strategies will support grid-connected operations:

Feed-in tariffs. To ensure a stable pricing policy, the Federal Government introduces feed-in tariffs for small hydro schemes not exceeding 30MW, all biomass cogeneration power plants, solar and wind-based power plants, irrespective of their sizes. Specific tariff regimes formulated by NERC shall be long term, guarantee buyers under standard contract and provide reasonable rate of return.

Access to the grid. NERC shall promote the generation of electricity through renewable sources by providing suitable commercial and technical measures for connectivity to the grid and sale of electricity to any persons. Commercial regulations encompass permitted renewable energy fuels, application and connection procedures, costs incurred by each party, tariffs, and billing arrangements. The technical regulations shall specify the requirements for a renewable energy generator to connect to the grid. These include responsibilities of each party; criteria for synchronization (acceptable voltage levels, frequency, power factor, etc.) required protection relays, and provisions for emergency disconnect.

Development of a Standard for Power Purchase Agreements. NERC shall develop an appropriate standard or model for PPAs. The PPA sets the terms by which power is marketed and/or exchanged. It shall determine the delivery location, power characteristics, price, quality, schedule, and terms of agreement and penalties for breach of contract. It shall among other things, ensure that prices provide an adequate return on investments in renewable electricity; standardizes and simplifies contractual relationships; and protects investors, utilities and consumers.

Tariff regulation. Subject to the provisions of this Policy Guideline, NERC shall specify the terms and conditions for the determination of tariff, and in so doing shall be guided by the promotion of renewable sources in electricity production.

(See also Annex 11)

7 Other Developing Countries

7.1 PR of China

7.1.1 Renewable energy law

On January 1st 2006, the Chinese Renewable Energy Law came into effect, which put forward a comprehensive renewable energy policy framework. The law institutionalizes a number of policies and instruments for China's renewable energy development and utilization, which cover indicative renewable energy targets, renewable energy planning, entry of renewable energy products to the market, grid connection of renewable power generation project, feed-in-tariff of renewable power generation, fiscal and taxation measures, renewable energy technology R&D and diffusion, and renewable energy education and training.

7.1.2 Feed-in tariff

The China Renewable Energy Law has defined the guiding principles of China's Feed-in Tariff approach, and requested the government to formulate concrete measures to implement the approach. Some directives regarding feed-in tariff implementation have already been enacted in China, such as Directive on Renewable Energy Power Generation and Directive on Renewable Power Pricing and Incremental Cost Sharing. A premium of 0.25Yuan/kWh is now available for biomass power generation projects. So far wind power generation projects are not eligible to enjoy the incentive, and the pricing of wind power is still decided through public bidding.

7.1.3 Special fund for renewable energy development

A Special Fund for renewable energy development has been endorsed by the Renewable Energy Law. The Special Fiscal Fund is a very important financial facility for the development and deployment of renewable energy technologies in China. The Ministry of Finance issued the Management Method on Special Fund for Renewable Energy Development in June 2006, making the Fund be available for renewable energy projects. The Fund supports investments in renewable energy projects by providing grand or subsidizing low interests.

7.1.4 Taxation measures

The Renewable Energy Law has recognized the importance of these measures, and requested the relevant government departments to formulate concrete fiscal and taxation measures such as tax and/or tariff relief and preferential loans to support China's renewable energy industry development. Now wind farms enjoy a 50% reduction in Value Added Tax. Other taxation measures in favour of renewable energy investment and use are under formulation or investigation.

7.1.5 Grid access

The Renewable Energy Law has several provisions targeting the removal of barriers of the entrance of renewable energy power to the energy markets. Directive on Renewable Energy Power Generation, issued by NDRC, is the Law's implementing regulation which states that the grid has to give priority to the access of renewable energy sources. The Ministry of Construction has also issued regulations on installation of solar heating in buildings.

7.1.6 Government targets

Today, modern renewable energy sources account for 7.5% of China's primary energy demand. Besides modern renewable energy, traditional biomass also plays an important role in the China's energy mix, which makes up about 12%. The share of renewable energy in electricity generation is 15%, with hydro power plants the largest technology. About 80% of Chinese primary energy supply still comes from fossil fuels. The Chinese government has set a target that by Year 2020, renewable energy sources will make up 16% of the total primary energy mix. Among those, decentralised renewable energy systems, where power and heat are produced close to the point of final use, plays an important role in supplying electricity to rural population in remote areas.

7.1.6.1 Hydro

The commercially exploitative hydro resources in China amount to 400 GW. By the end of 2005, the installed capacity of hydro power reached 110 GW with the annual generation of about 400 TWh. The development targets for hydro power are to reach 180 GW by 2010 and 300 GW by 2020. China has mastered advanced technologies of designing and constructing hydro power projects, as well as manufacturing the equipments. However, the bottlenecks for developing hydro power are the concerns over the local ecology and the human displacement.

7.1.6.2 Biomass

Biomass includes agricultural and forestry residues, oil plants, methane and other organic wastes. Traditional biomass refers to agricultural and forestry residues burned directly for cooking and space heating in rural households. Traditional biomass is still the main source of energy supply for the 15 million of Chinese rural population, who do not yet have access to electricity. By the end of 2005, the installed capacity of modern biomass power was 2 GW. The annual production of ethanol and methane was 1.02 million tons and 8,000 million m, respectively. The governmental targets are to have modern biomass plants with installed capacity of 5,500 MW by 2010 and 30,000 MW by 2020. For methane, the targets are 19,000 million m3 and 44,000 million m3, respectively.

7.1.6.3 Wind

Based on the assessment of the Chinese Metrological Bureau, the total exploitative wind resources in China is about 1,000 GW, with 250G W of onshore and 750 GW of offshore. By the end of 2005, over 60 wind farms were built with a total installed capacity of 1.26 GW. The total installed capacity increased by 65% in 2005 and then 80% in 2006. China plans to install 5GW wind power by 2010 and 30GW wind power by 2020. In order to facilitate the localization of wind energy equipment manufacturing, which is key to the wind energy development in China, the NDRC has set a 70% wind turbine localization requirement for any new wind farms since July, 2005.

7.1.6.4 Solar

Two thirds of the land in China has a yearly sunshine duration over 2,200 hours. By 2005, the installed capacity of solar photovoltaic was 70 MW. High price of solar PV is still making this technology prohibitive. On solar heating, the yearly production capacity has reached 15 million m and the total coverage has reached 80 million m; both are ranked No.1 in the world. Also, solar power plays a very important role in decentralized system, which supplies electricity to rural population in remote areas. The targets are by 2010, China will have 300 MW installed capacity of solar power and the figure will rise to 1,800 MW by 2020.

A copy of the law (unofficial, English translation) can be found in Annex 8.

7.2 Connection of micro/mini hydropower plants (<1000 kW) to the national electricity grid – The example of Nepal

7.2.1 Background

Access to electrical energy is not just essential from the point of social justice but is also required to bring forth changes in the areas such as education, access to information, and to curtail adverse impact on environment due to use of kerosene lamps as well as haphazard extraction/use of fuel wood. The lack of access to electricity in the rural areas has been considered as one of the major hindrances to rural development in Nepal.

Apart from the potential for developing hydropower, Nepal does not have other significant sources of conventional energy such as fossil fuels. Ample water resources availability and the topographic situation give rise to a potential for about 42,000 MW of techno-economically feasible hydropower. However, to date, electricity supply has reached to only 7 percent of the rural population. Due to unaffordable high electricity tariff coupled with low purchasing power of the people and limitation of resources within the government, the growth in rural electrification has been slow.

This concept paper discusses the need for and benefits accrued from connecting micro/mini-hydropower plants to the national electricity grid in the event the grid reaches the micro/mini-hydropower plant's distribution area.

7.2.2 Historical development

Plants up to 100 kW are called micro hydro plants in Nepal. These plants were introduced in Nepal in the 60s with the locally developed turbines to replace diesel engines used in the hills for agro-processing. Prior to the introduction of micro hydro plants, it was an irony that the power from the abundant streams nearby remained untapped, while the villagers carried imported diesel on their backs from town centres, days away, to operate the diesel mills. With the success of production of locally built turbines, and credit facility available from Agricultural Development Bank, orders for micro hydro came from village entrepreneurs who wanted to set up agro-processing mill – a paddy mill, oil expeller and grinder, the most universal applications.

By early 80s, came a number of turbine mills with small dynamos generating electricity for the operation of the mill during the night time and also supplying power to light a few houses nearby. The potential of a turbine mill to power electric lights was demonstrated when the small town of Malekhu in the Prithvi Highway was electrified from a turbine mill owned by a local entrepreneur in early 80s. Seeing this success, Agricultural Development Bank began promotion of electricity generation from turbine mill by providing 50% subsidy on the cost of the electrical components of micro hydro plants. While the government initiated small hydro development projects were finding difficult to find its feet on the ground, unable to raise enough revenue to pay for operation and maintenance, the private sector led micro hydro electric plants, with villagers in remote areas as the driving force, flourished. And the stand alone micro hydro came to be coveted by villages in remote areas as far as Mustang (a mountain community located 4 days' walk from the nearest road head). Once a village glows with electric lights, the neighbouring village just couldn't stand to live in darkness. This is how micro hydro spread - by 'word of mouth' and people power (i.e. their ability to organise themselves) in contrast to government aid small hydro projects that came as a 'gift' or 'aid' from outside.

As a result of the four decades of efforts by NGOs, the government, financing institutions, and the private sector, including rural entrepreneurs, Nepal today has a micro hydro sector that is thriving and is a good example for other similar mountainous countries to learn from. To date over 2000 micro-hydro electrification schemes with a total installed capacity of about 7.5 MW have been built in the hills and mountains of the country. Similarly, over 800 turbine mills and over 870 improved water wheels (Ghatta) have been established. Currently, Danida has been actively assisting Alternative Energy Promotion Centre (AEPC) of His Majesty's Government of Nepal (HMGN) in promotion of micro-hydropower sector through its Energy Sector Assistance Program (ESAP).

7.2.3 RATIONALE FOR CONNECTING MHP PLANTS TO THE NATIONAL GRID

As a result of combined efforts of HMGN and donor support, the micro-hydropower sector has been expanding rapidly. During the Ninth Five Year Plan (1997 - 2002), HMGN had set a target to implement an additional 2 MW of micro-hydropower plants. This target has been met. Encouraged by the achievements of the Ninth five Year Plan, HMGN has now increased the target by five fold, i.e., achieving 10 MW of additional micro-hydro installation by the end of the 10th Five Year Plan (2002 - 2007). It should be noted that a significant subsidy amount has been disbursed to achieve the target of the 9th Five Year plan and a five-fold increase in subsidy is required to meet the 10th Five Year Plan target.

On the other hand, equal priority is being given to the grid based rural electrification extension. Various programs such as financial support of 80% of the total cost for establishment/expansion of grid based distribution network in the rural areas to the community and handing over operation and management aspects of existing rural electricity distribution network to rural communities are some examples.

As a result of the two-pronged policies of supporting grid extension and implementation of isolated micro hydropower plants, rural electrification is now expected to be implemented at accelerated pace. Moreover, the electricity grid has already reached several distribution areas served by isolated Micro-hydropower plants. It is worth noting that if rural electrification continues at the present pace, the grid will reach more distribution areas currently served by isolated micro-hydropower plants.

As per the Electricity Act, NEA is required to purchase the micro-hydropower plant from the owner in the event that the national grid reaches his/her distribution area. Clause 30 of the Act states, ***"In case where the licensee is going to distribute electricity in an area where any person or corporate body is already distributing electricity, such person or corporate body who is generating hydro-electricity up to 1000 kW if desires to sell the hydro-electricity plant, transmission and distribution line which is operated by him, the said licensee shall have to purchase such hydro-electricity plant, transmission and distribution line on the price (after deducting wear, tear and general depreciation) as fixed by mutual agreement."***

As NEA is the only utility that undertakes extension of the national electricity grid, according to the Electricity Act, it would be NEA by default that would have to purchase the micro and mini-hydropower plants and the distribution networks. As a centrally managed utility having vast institutional experience in the electricity generation, transmission and distribution sectors, NEA's strength lies in:

- Its access to a large pool of human resources including numbers of hydropower subject specialists capable to design, construct and operate hydropower plants.
- Its ability to coordinate supply and demand of electricity nationwide.

- As a state enterprise it also benefits from the backing of HMGN and thus has the credit-worthiness to collateralize big loans and to receive licenses to survey hydropower projects and to eventually implement such projects.

Given its strengths, institutional structure and the mandate to supply electricity nationwide, it would be more appropriate for NEA to develop larger projects and let the private sector manage, implement and operate isolated micro and mini-hydropower plants. Compared to the private sector (local entrepreneurs), in the field of micro and mini-hydro and extension of rural distribution network where economy of scales do not apply, NEA may have high overhead costs, which significantly adds on in the implementation as well as operation and maintenance costs.

Since managing micro and mini-hydro is more of a burden for NEA, the practice has been to abandon the plant after purchasing it from the owner. This is a gross waste of resources; especially since most micro-hydropower plants are constructed with government subsidy. If adequate attention including formulation of appropriate policy mechanisms is not given, more micro-hydropower plants are likely to be abandoned. The optimum use of resources in such circumstance would be to have the micro-hydropower plants feed electricity into the national grid. Such practice would result in the following advantages:

1. **Advantage for the local population / plant owner**: The current school of thought is that access to electricity contributes positively towards poverty alleviation. However, the approach of "a Rupee saved is a Rupee gained" is not well comprehended at the community level, i.e., savings on kerosene lamps, lower medical expenses due to improved indoor environment etc. Although, quality of life surely enhances with provision of electric lights, the cash flow requirements (e.g., payment for tariff, O & M etc.) of the community becomes an increased responsibility. Ideally, if the income of the community could also be raised through sales of electrical energy to the grid, the socio-economic condition of the community would be significantly enhanced. Similar experience has been gained in Switzerland, which is discussed in the subsequent section of this paper. Sales of electricity to the grid can either immediately yield profits to local people if they are shareholders (i.e., community owned plant) or indirectly if the owner of the system due to "legislative regulations" has to share his profits with the district whose resources he is exploiting.

2. **Advantage for NEA:** NEA need not purchase the micro-hydropower plants that it has no intention of using. Instead it can enter into a Power Purchase Agreement (PPA) with the owner and purchase electrical energy. If appropriate policy is developed, a win-win condition may be reached whereby NEA receives electricity at nominal price (taking into consideration the subsidy received by such plants) and the plant owner would also receive additional income due to access to electricity market via the grid at all times.

3. **Advantage for Government / subsidizing agencies:** With connection to the grid, the utilization of the micro-hydropower plants (i.e., load factor) increases which results in additional income as discussed earlier. Such addi-

tional income to the plant owner may even justify the government to recoup part of the subsidy that was awarded for plant installation. Such subsidy, for example, can be recouped by excluding the pro-rata amount of subsidy for the purpose of computation of tariff for signing a PPA with NEA for supply of electrical energy to the national grid. Another option could be to convert part of the subsidy into loan based on depreciation and years of plant operation prior to grid connection. Thus, more funds can be made available to subsidize micro-hydropower plants located further away from the electricity grid.

4. **Technical advantage**: In order for micro-hydropower plants to supply electrical energy to the national grid, it would have to be synchronized with the grid. Such synchronization requires the technical quality of the micro-hydropower plants to be high, i.e., voltage and frequency have to be well maintained. Thus, requiring micro-hydropower plants beyond a certain size (say 20 kW) to be synchronized with the grid would inherently ensure high quality.

Although, connection of micro-hydropower plants to the national electricity grid is a new concept and has not been tried out in Nepal, this is a normal practice in developed countries. For example in countries like Norway, Germany and Switzerland, even fractions of a kW generated by either hydro or solar power are synchronized at household level with the national grid. Thus, entrepreneurs are able to sell excess electricity to the grid. Therefore, the technology and know how regarding the connection of micro power plants to the grid is well established.

The current practice in the Nepalese **small hydropower** sector is that Independent Power Producers (IPP) who are wealthy business persons invests in hydropower plants to supply electrical energy into the national grid based on PPAs. Apart from employment opportunities for the local residents mostly as unskilled labour during the construction period and some annual royalty amount to the concerned DDCs and VDCs, the local population does not reap much long term benefit from the development of such small hydropower plants. Even electrification of areas in the vicinity of the powerhouse is not always ensured. The IPPs on the other hand are able to make significant profit from such power plants. Given the current power purchase rates, they are generally able to recover their investment within at most eight years.

On the other hand, **micro-hydropower** plants working in isolated mode are either owned by local entrepreneurs or the community. In both cases, since the ownership lies within the local community, any income accrued from the micro-hydropower plants is more likely to benefit the local economy unlike the small hydro where outside investors look for attractive opportunities in the urban areas or invest in developing similar small hydropower plants. Thus, enhancing the income from micro-hydropower plants such as by selling electrical energy to the grid would reverse the direction of the capital flow. The urban electricity consumers' money would flow back to the rural areas. It is worth noting that such a system has been successfully demonstrated in Switzerland as briefly discussed hereafter.

7.2.5 The Swiss micro-hydropower situation as a model for the development in Nepal

Today, in Switzerland, 60 % of electricity generation is based on hydropower and 40 % on nuclear power. The Cantons are entitled to the rights of disposal on hydropower. They can confer the rights to the communes and other corporate bodies. Despite the cantonal freedom to charge the so-called water royalty („Wasserzins"), the national government determines the calculation method and the maximum amount of the royalty. Since the adoption of the water royalty, 80 years ago, it has increased from 4.6 USD per horsepower (or USD 6.2 per kW) to 61 USD per gross kilowatt. Power plants of less than 1 MW are exempted from this royalty. Mostly, the cantons and communes do not exercise the rights on their own but rather confer them to private sector concessionaires. Consequently, besides the ecological advantage, hydropower is an important economic factor. The mountainous cantons receive an estimated 765 million USD of revenues per year due to water royalty, taxes, compensations, investments and salaries. The water royalty alone provides the cantons and communes with 306 million USD, corresponding to 0.01 USD/kWh (0.012 CHF/kWh)[14]. For instance, about 25 % of the total public revenues of Canton Uri originate from hydropower. Additionally, the hydropower sector safeguards jobs - all the more important in the economically weaker mountainous regions - it contributes to flood protection, to a high inland value added and to road infrastructure and thus mainly serves the local population. The latter often benefited due to improvement of (access) roads, water supply and other accompanying measures of power plant implementation and last but not least even remote valleys were connected to the network. Most of the power plants are subject to devolution which means that after expiration of the concession the whole plant and machinery vest in the canton and the commune, one half each. In addition to financial obligations, the licensee can become committed to provide a certain amount of free electricity or "preferential electricity" (at a reduced price) to the commune bestowing the water right. This cheap energy can either be used for a targeted economic policy or to replenish the commune funds. Although, from the operating company's point of view, the above mentioned costs of hydropower use are about five times higher than in the neighbouring countries, finally the general public benefits thereof. Even the "non-concession" communes profit indirectly from these revenues via the inter-commune financial equalization to which the concession communes pay a so-called solidarity share. Today a canton or commune has two possibilities to create additional income out of its hydropower resources:

1. conferment of water rights to others, e.g. private sector utility, and benefit from water royalty payments
2. exercising the water rights on its own (benefiting from electricity sales) in the form of:
    a) municipal department (commune as operating agency within the scope of its general communal administration)

[14] Electricity tariff about 0.15 USD/kWh (0.2 CHF/kWh); 1 USD = 1.278 CHF

b) municipal utility (commune as operating agency but in the form of a separate estate with independent accounting) or

c) municipal company (operating agency in a private legal form belonging to the commune)

At present independent electricity producers based on renewables receive about 0.12 USD/kWh[15] for electricity fed into the national grid. These include micro hydropower plants with installed capacity of a few kW to 1 MW as well as household based solar cells which supply 10s of kW (umpteen of kWs) to the grid. For hydropower this payment guarantee is limited to plants below 1 MW. For larger plants, the rate is to be negotiated with the respective utility and the current ongoing price is around 0.06-0.09 USD/kWh. A global reduction, for so-called system services, of up to 13 % can be raised by the utility.

Unfortunately, the extra costs to guarantee 0.12 USD/kWh for renewable energy fed into the grid have to be covered by the local public utilities on lowest level. It was planned that the cantons establish equalization funds - fed by all power producers, transmitters and distributors in the canton - in favour of those public utilities which have to buy disproportionately much from independent producers. Nevertheless, none of the cantons has done so. Therefore, it is now planned to establish a "federal grid corporation", financed by the cost covering operation of the national grid. As soon as this corporation covers the additional costs to guarantee the "feed-in tariff" of 0.12 USD/kWh the local utilities will no longer try to avoid the extension of decentralised renewable power generation as they did so far.

7.2.6 Conclusions from the "Swiss Model" to the Nepalese context

As discussed earlier, the "Swiss Model" demonstrates that the local community can benefit from different sizes of MHP plants if the legal and political conditions are suitable. In Switzerland, for plants below 1 MW (which are exempted from water royalty) the regional authority can benefit by means of exercising the water rights on its own, operating a plant as municipal department, utility or company. For plants exceeding 1 MW installed capacity, the local population benefits due to payments of water royalty. A further important lesson to be learned is the concept of a guaranteed feed-in-tariff for plants below 1 MW and the redistribution of the funds (required recovering high tariff) onto the national grid. Decentralised MHP plants contribute to a reduction of transmission costs and should therefore be financially supported based on the concept of avoided costs.

Historically, Swiss MHP plants working in an isolated mode were first given up when the national grid started to be quickly extended and several large hydropower plants were built. Only the convenient political and legal framework facilitated numerous revitalizations of MHP plants, which nowadays are operated in an economically sustainable manner.

[15] market-oriented subscription price according to avoided costs for procurement of equivalent energy

Way Forward

The Swiss MHP model has demonstrated that it can alleviate "rural poverty" by providing the community with a constant source of income. If a similar model is to be adopted in the Nepalese context, the following issues need to be addressed:

- The Electricity Act needs to be amended such that the local body (i.e., concerned VDC) has the legal rights to the local water resources and is thus able to award such rights to the interested developers. Similarly, the Act should allow NEA to enter into power purchase agreement with the micro and mini-hydropower plants instead of purchasing the plant itself. Such amendments would also be in line with the spirit of decentralization and the "Local Self Governance Act".
- Several pilot projects should be undertaken to demonstrate the technical and financial viability of synchronizing micro and mini-hydropower plant with the national electricity grid.
- Model PPA documents need to be formulated to facilitate exchange of electrical energy between the micro and mini-hydropower plants and the electricity grid. Such a model PPA should be simple, transparent, easy to administer but at the same time effective.

7.3 Mini Hydro Power Project - Indonesia (MHPP)

Indonesia's first Mini Hydropower Project has been successfully commissioned under the new Power-Purchase Agreement – PPA. This case study can give an overview of how mini hydro can be commercially viable in Asia if a PPA is established

The first Small Private Renewable Energy Power project in Indonesia since the introduction of the PPA legislation for small power producers in 2002 was successfully commissioned on 20-21st October 2003. The 25 kW scheme is owned and managed by a NGO (nongovernmental organisation), the local community and the municipality of Seloliman, East Java, an informal traditional village institution.

The implementation represents a major milestone for the emerging Indonesian renewable energy sector. The scheme was first built in 1993 by GTZ-MHPP (GTZ-project on micro hydro-power) in cooperation with Indonesian knowledge provided by European expertise to provide electricity to the Environmental Education Centre. Inter-connecting and selling the excess power to the public utility PLN grid represents the final stage in the schemes 10-year evolution. In 2000, the electro-mechanical equipment was replaced as part of an up-grade increasing the output to its present capacity of 25kW. This up-grade was carried out with support provided by GTZ-MHPP in cooperation with (YBUL, a NGO) through their GEF (global environmental facility) small project facility. As part of the up-grade a number of local village enterprises were connected to the supply to improve its daytime usage for productive purposes.

This event represents a major landmark for the Indonesian mini hydropower sector. More than 10 years after the first discussions on the introduction of legislation permitting grid connection of small renewable energy projects, a fully-fledged project running and selling power to the grid. The scheme is connected at medium voltage (20 kV) and sells to PLN at Rp.425 / kWh (approx. 5 US cents). The scheme will generate approximately Rp 5 million/month gross revenue via this power purchase agreement. The technology transfer component of this scheme represents the continuation of a cooperation initiated by MHPP in1995 with UK supplier of electronic control equipment. Following the successful introduction of Electronic Load Control technology to Indonesia via the project component "technology transfer", the cooperation was extended to include an inter connection equipment, which works in combination with the load control unit. The Seloliman scheme is the first of two demonstration projects initiated by MHPP together with the Indonesian Directorate General for Electricity and Energy Utilization.

(See also Annex 12)

7.4 Vietnam

7.4.1 Tariff policy and the subsidy mechanism

1. It is the policy of the Government of Vietnam that a uniform national tariff shall apply to all grid-connected customers, *regardless of the actual cost of service*: residential customers served directly by EVN and the Power Companies (PC) enjoy a tariff of 700 VND/kWh. But this admirable policy of social equity does not apply to third-party resellers or off-grid entities, whose tariff is bounded only by PPC approval, and who are in theory able to set tariffs at any level deemed reasonable.

2. This raises a range of issues not just of social equity, but also of awkward incentives. Under the competitive generation market, it seems likely that there will be a single uniform bulk supply tariff. This calls for an efficient redistribution of funds (cross-subsidization) to those PCs with high cost structures due to large numbers of rural customers. Unless such a new mechanism is in place, the PCs will continue to have little incentive to expand the grid into remote areas.

3. The question therefore becomes whether the new cross-subsidy mechanism would also be available to *off-grid* electrifications? It would hardly be equitable if that new mechanism provided the incentive for grid-extensions, but not for off-grid electrifications, for the many cases where off-grid, renewable energy powered micro-grids are the *least cost* electrification option.

7.4.2 Productive Use

4. Increasing the extent of productively used electricity is crucial to the financial viability of the LDUs. Because the marginal costs of providing power during the off-peak daytime hours are essentially zero, this also significantly improves economic returns. A number of surveys have revealed that one of the main factors that inhibit conversion from diesel to electric devices (risk huskers etc) is the cost of electric equipment. These same surveys also show that if this equipment were provided to potential users as one of the capital costs of the project, they would be prepared to pay a significantly higher tariff than domestic customers.

5. Unfortunately, one of the difficulties is that some donors have been reluctant to promote the use of equipment for productive use since they see their focus on domestic electrification and poverty alleviation. To make the case requires preparation of a succinct paper that demonstrates the economic and financial advantages of such equipment funding, an analysis that does not appear to have prepared to date in sufficiently persuasive terms. Provisions for a productive use equipment credit facility (recovered by a higher tariff, by a leasing scheme, or with the involvement of a microfinance credit facility) should become part of the Government's overall policy directive on off-grid electrification.[16]

[16] Area 6 of the existing VSRE scope of work is focussed on creating awareness of productive use opportunities, but stops short of examining the financial implications and recommending specific options.

7.4.3 Rehabilitation

6. There are hundreds of off-grid small hydro projects in Vietnam owned and operated by a variety of LDUs (of differing legal form). Many of these are in need of rehabilitation. Some of these are expected to be sufficiently close to a transmission line when the grid is extended, to allow connexion to the grid. Selling their surplus energy to the national grid would generate substantial revenues. Thus, integrating these schemes into entities responsible for O&M of new off-grid schemes can bring otherwise unviable off-grid schemes into robust financial health – which is the idea behind the DOME concept of a District-wide Operation and Maintenance Entity (see e.g. Muong Te / RARE).

7. The VSRE institutional models report discusses the rehabilitation of the Nam Si Luong project in some detail. What went wrong is clear enough (as the report finds): problems with the design; poor commissioning; poor maintenance due to lack of adequate operator training. Efforts of the PC/EVN to help were useful, but limited to one-off assistance. The question for this study is how to mitigate such problems in the future: what can be done to provide remote MHP-schemes rapidly with assistance and support, when help from outside is needed. In Sri Lanka, user forums where village hydro operators could exchange information and experience have been a crucial ingredient for success: but such institutions themselves need stable funding for which a mechanism would need to be defined.

7.4.4 Managing the transition to grid connection

8. Over the past few years the Government has devised a coherent framework for larger grid-connected renewable energy projects, including a standardised power purchase agreement, a published avoided cost tariff, a grid code, and greater clarity for licensing requirements – a framework that is expected to be in place within the next year.

9. While in principle these apply to smaller projects as well, transaction costs need to be further reduced, and some of the requirements further simplified. For example, the SPPA contains a requirement that sellers provide buyers with year-ahead forecasts of energy production, and submit at the time of SPPA signature estimates of energy data for every month of the hydrological record (so that the buyer can assess the impact of annual and seasonal variability). These requirements should clearly not be required for the 50kW size-range electricity generation.

10. Indeed, at this scale, the perspective should be not one of connecting to the *grid* as a generator, but connecting to the *distribution* network as a negative load. What is therefore required is – similar as it has been coherently achieved for the larger grid-connected renewable energy projects – the development of a framework to enable distributed generation. In principle, the transaction costs of connecting a 10kW generator should not be any different than connecting a 10kW load, and should certainly not require a detailed legal agreement.

11. A number of commune electricity management boards (CEMBs) have been "negotiating" with EVN to secure a higher tariff for sales to the grid – for generators rarely much above 100kW. Since this is increasing transaction costs, it is as undesirable as a potential buyer negotiating with EVN for the *purchase* of a corresponding load. Retails tariffs (at this scale) are what they are, and are not negotiable, so why should generation tariffs be negotiable? Indeed, one may note that a small hydro facility that supplies a village is by definition already connected to the distribution network, so unlike the case of new 10kW load, there should be no issues regarding connection fees.

7.5 Thailand[17]

7.5.1 Thailand's renewable energy targets

The Thai government has set a target that 8% of all commercial energy in Thailand will come from renewable energy sources by the year 2011. In a 2 November 2005 presentation by the Ministry of Energy, this target has been further broken down to the following: 1000 kTOE (11,600 GWh) per year to come from renewable electricity (solar, wind, biomass, municipal solid waste, etc.); 2,500 kTOE per year to come from renewable transport fuels (ethanol and biodiesel), and 4,200 kTOE per year to come from renewable energy use for heat (Thai Ministry of Energy 2005c). Currently, Thailand is far from this target. New and renewable energy accounts for less than 0.5% of total commercial energy

The same Thai Ministry of Energy presentation expresses the renewable electricity target as an installed generating capacity of 2,200 MW[18], of which the Ministry estimates that 860 MW are already installed leaving an additional 1340 MW remaining to be installed by 2011.

It is noteworthy that these target amounts have fluctuated somewhat in the past few months, and therefore may be expected to continue to fluctuate as the policy is finalized. An October 2005 Thai Ministry of Energy document expresses the 8% renewable electricity target as 2,400 MW of which 883 MW are already installed (Thai Ministry of Energy 2005a).

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[17] Prepared by:Chris Greacen, Ph.D., (Palang Thai); Detlef Loy, Dipl.-Ing., (Loy Energy Consulting); Prepared for: Joint Graduate School for Energy & Environment, March 2006

18 It is also noteworthy that the 2200 MW installed renewable energy "target" may or may not provide sufficient renewable energy to meet the 11600 GWh per year renewable electricity objective. The Ministry of Energy's 2200 MW figure implies a capacity factor of over 60% for renewable energy. Different renewable energy sources have different capacity factors. Wind power in Thailand is estimated at around 15%, whereas some biomass condensing turbine installations may be as high as 85%. Depending on the Thailand's future mix of renewable energy sources, the actual installed MW may have to be higher or lower to meet the 11600 GWh per year target. Considering that much of Thailand's future renewable energy will probably come from biomass operated in a combined heat and power (CHP) plant, and that CHP typically operates at lower than 60% capacity factor (Black and Veach, 1998 estimates bagasse cogeneration at 29% capacity factor), the 60% assumption by the Ministry may be too high.

7.5.2 Feed-in tariff is key mechanism to meet Thai target

To meet the year 2011 installed capacity target of 1,340 MW the Thai Ministry of Energy has proposed several different mechanisms. An obligatory quota system (often referred to as the Renewable Portfolio Standard, or RPS) is expected to procure 140 MW. *The remaining 1200 MW (90% of the total renewable electricity target) is left to a feed-in tariff.* Additional complementary policies under consideration include: income tax privileges, low interest loans, and a carbon credit (Thai Ministry of Energy 2005b). Renewable energy projects currently enjoy the following Thai Board of Investment (BOI) privileges: corporate income tax exemption from 3-5 years; accelerated depreciation of the cost of installing or constructing facilities; double treatment of costs for the purpose of calculating income; approval for remittance of money in foreign currency; authority to lease or exclusively occupy and use land; authority to bring foreign experts, technicians and staff; exemption from or reduction of import duties on equipment and machinery used in the construction and operation of the project (Pacudan 2003).

Because of the importance assigned to the feed-in tariff in meeting the target, because of the substantial amounts of (rate-payer or taxpayer) money involved, and because of the rapidly approaching target date (2011 is only 5 years away) it is essential to implement a feed-in policy *that works and delivers substantial quantities of renewable electricity at reasonable cost* in Thailand, and to do so quickly so that the results will accumulate with minimum delay.

7.5.3 The feed-in tariff system of Thailand

A feed-in tariff is a favourable per-kWh price paid for electricity from renewable energy resources over a determined period of time (typically 15 to 20 years). Electricity generation projects – in particular with high up-front investment costs as for renewable energy installations - require a reliable, stable long-term revenue stream in order to obtain finance at a reasonable cost. Well-designed feed-in tariffs have proven to be one the most effective policy instruments for providing this necessary stability for grid-connected renewable electricity projects at least in their initial phase of market introduction.

Feed-in tariff: (n) a favourable per-kWh price paid for electricity from renewable energy resources over a determined period of time.

A recent report by the Worldwatch Institute notes that feed-in tariffs are the most common renewable energy policy. By 2005, at least 32 countries have adopted feed-in tariffs, more than half of which have been enacted since 2002. Developing countries that have reportedly implemented some form of feed-in tariffs include India, Brazil, Sri Lanka, Indonesia, Costa Rica, and Nicaragua (Martinot 2005).

Feed in tariffs have been very successful at fostering renewable energy deployment and the development of renewable energy industries. A study of wind turbine manufacturing in 12 countries found that long-term, stable feed-in tariffs have proven to be the most successful mechanism for promoting wind energy utilization and wind manufacturing to date.

Countries that use feed-in tariffs tend to have more success in attracting investors for renewable energy than countries that use quota systems (RPS). Several studies of renewable energy policy in Europe found that prices for renewable energy under feed-in tariff arrangements tend to be cheaper than those in countries that use a combination of mandatory quotas and green certificates (Mitchell, Bauknecht et al. 2003; Fouquet, Grotz et al. 2005).

It is important to recognize, however, that feed-in tariffs by themselves will not ensure that Thailand's renewable energy targets are met. Accompanying feed-in tariffs, it is also essential for Thailand to make progress on:

developing a independent, competent, empowered regulator

- barrier-free grid access
- efficient planning and permission procedures
- willingness of financial institutions to loan for renewable energy projects at comfortable interest rates, as well as knowledge to properly evaluate renewable electricity projects.

Finally, it is worth emphasizing that while feed-in tariffs have been an important part of successful renewable energy policy packages in other countries, the success is not guaranteed in Thailand. Care must be taken to establish feed-in tariffs correctly in order to ensure investor confidence on the one hand, while at the same time maximizing benefits from rate-payer or taxpayer funds. Unresolved issues of key importance with respect to feed-in tariffs for Thailand are:

- legal basis / enabling legislation
- where the money will come from (funding mechanism)
- reasonable tariff levels for different technologies

7.5.4 A survey of proposals and studies in Thailand towards establishing feed-in-tariffs

Important work has been done by Thai groups towards establishing appropriate levels for feed-in tariffs. Most of the work has focused on trying to systematically determine appropriate feed-in tariff levels using an "IRR" approach that seeks to set feed-in tariffs for each chosen technology at a level sufficiently high that a well-run business can make a reasonable profit. The groups include the Promotion of Renewable Energy Technologies (PRET) group at the Department of Alternative Energy and Energy Efficiency (DEDE) in the Ministry of Energy, the Energy for Environment Foundation, the Electricity Generating Authority of Thailand (EGAT), and the Federation of Thai Industries (FTI).

Among these, the DEDE's work has attracted the highest level of attention to date. DEDE suggestions for feed-in tariffs have been shared in a number of meetings with the Thai Energy Minister

Promotion of Renewable Energy Technologies (PRET) group at the Department of Alternative Energy and Energy Efficiency (DEDE) 2005

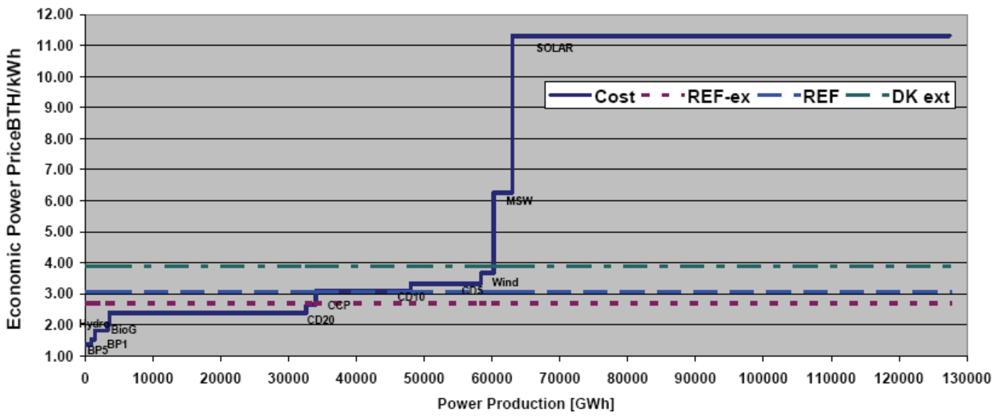
A study, entitled "Economic and Financial Analysis of Renewable Energy Development in Thailand" by the Promotion of Renewable Energy Technologies (PRET) group at Thai Ministry of Energy DEDE is the most recent effort towards determining appropriate feed-in tariffs. The study examines the economic and financial viability of a number of renewable energy technologies, and estimates the economically optimal quantity of renewable electricity for Thailand. Furthermore, it develops several scenarios based on different financial incentives schemes. The PRET study has developed two spreadsheet models that make explicit key assumptions and allow users to change variables and observe outcomes.[19]

The PRET study first investigates the *economic* cost of renewable energy:

Economic cost of power production	BTH/ kWh
Conventional	3.07
Municipal solid waste	6.27
Biomass back pressure, 1 MW	1.38
Biomass back pressure 5 MW	1.22
Biomass Combined Cooling and Power	2.66
Biomass condensing, 20 MW	2.41
Biomass condensing, 5 MW	3.34
Biomass condensing, 10 MW	3.09
Biogas electricity generation	1.82
Mini hydro (200 kW - 6 MW)	2.02
Micro Hydro < 50 kW	2.30
Wind farm, 20 MW	3.67
Solar PV large scale	11.31
Solar PV Residential	14.66

Economic cost of power production (Thai Ministry of Energy 2005a)

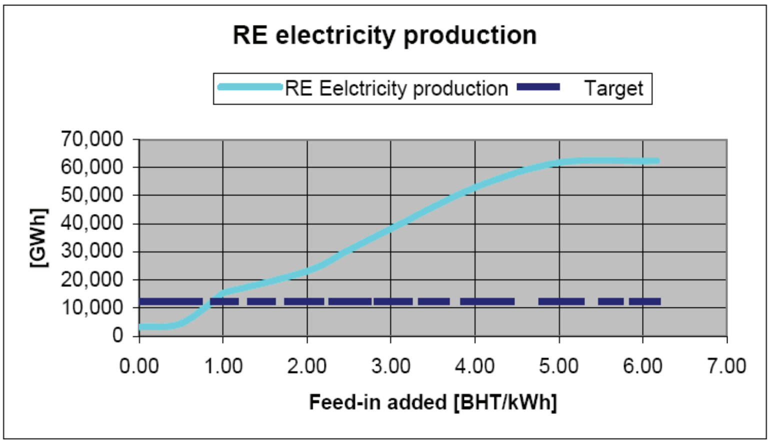
Based on these costs and on estimates of resource availability, the study determines a cost supply-curve for renewable energy in Thailand:



Cost supply curve for Thailand renewable energy. Source: (Thai Ministry of Energy 2005a). The dotted lines refer to externality cost estimates in Thailand (REF-ex) and in Denmark (DK ext).

[19] RETEAS: Renewable Energy Technology Economic Assessment Spreadsheet; RED Model: Renewable Energy Development Model

On the basis of this supply curve and the financial costs of renewable energy generation, the report models the impact of varying levels of feed-in tariff adder on renewable energy production:



Effect of feed-in tariff on renewable energy production. Source: (Thai Ministry of Energy 2005a)

The study finds that to reach a target of **5,989 GWh/year by 2011**, a feed-in adder of at least **1.8 baht/kWh** (above avoided cost levels) is needed. Such an "across-the-board" subsidy would result in nearly all new renewable energy being biomass-based, with a small portion comprising mini-hydropower.[20]

At a seminar on renewable energy in Haat Yaai on 20 November, 2005, DEDE Deputy Director General Amnuay Thongsathitya suggested the following tariffs:

Energy source	**(baht/kWh)**
Solar	15
Wind	5
Micro-hydro	3
Biomass	3.2 - 3.8
Municipal waste	5-6

Feed-in tariffs proposed by DEDE in 2005. Tariffs are based on calculations that aim for an IRR on equity of 11%. Source: (Thongsathitya 2005) (Since this time, DEDE may have updated tariff proposals, with more differentiation based on technology size. We are awaiting official release of citable documents showing this)

[20] It is not clear how to reconcile the stated 5,989 GWh/yr target with the 1000 kTOE per year (11,600 GWh/yr) renewable electricity target discussed on page 2 of this paper.

Federation of Thai Industries (2005) & EGAT (2003)

In an article in the Business section of the Bangkok Post, the Federation of Thai Industries (FTI)'s Renewable Energy Club was quoted as suggesting the following feed-in tariff values and contract durations:

Type	**FTI proposed price (baht/kWh)**	**Contract period (yrs)**
Solar cell	16	25
Wind Energy	6	15
Biomass	2.63 – 2.80	20
Biogas	3.40 – 3.50	n/a
Municipal waste	3.90	20

FTI proposed prices and contract duration for renewable energy. Source: (Jaiimsin 2005)

Sombat Teekasap, chairman of FTI's research and development committee, said that the FTI proposed prices are lower than costs estimated by EGAT in a 2003 internal study, but are high enough to attract private investment (Jaiimsin 2005).

Type	**EGAT 2003 internal study cost estimate (baht/kWh)**
Solar cell	21.36
Wind Energy	7.32
Biomass	2.63
Municipal waste	5.12

Cost estimates of renewable energy from reported EGAT internal study. Source: (Jaiimsin 2005)

Energy for Environment (2004)

In 2004 the Energy for Environment (E for E) Foundation published an EPPO-commissioned study to investigate potential support mechanisms for wind, solar and micro-hydropower. The study concluded that the *commercial cost* of production from various sources was as follows:

Wind commercial production costs

E for E calculates wind power unit costs to be 5.2 baht/kWh, based on Thailand's wind regime powering a 1000 kW turbine installed at 80 meters costing EURO1000 per kW with a lifetime of 20 years, O&M expenses equal to 2% of capital cost, financing through a 70:30 debt to equity ratio with debt serviced at 10% over 7 years, a financial internal rate of return (FIRR) of 10%, a discount rate of 6.5%, income tax of 30% after an 8 year tax holiday, and an exchange rate of 40 baht to $US (Energy for Environment 2004).

Solar commercial production costs

Grid-connected solar electricity commercial costs are calculated by E for E to be 10.1 baht/kWh, based on Thailand's solar insolation and on a solar module cost of US$2.381 per peak watt producing 3.45 kWh/kWp/day, with a lifetime of 25 years, O&M expenses equal to 0.1% of capital cost, an IRR of 10%, a discount rate of 5.75%, and an exchange rate of 40 baht to $US (Energy for Environment 2004).

Small and micro-hydro commercial production costs

The E for E study investigated commercial costs for micro-hydro to vary from 4.95 baht/kWh to 2.1 baht/kWh depending on plant size (varying from 20 kW to 100 kW with the higher tariff corresponding to lower plant sizes) and on plant factor (50% to 70%). Other assumptions included IRR of 10%, O&M expenses equal to 1.5% of capital cost, financing through a 70:30 debt to equity ratio with debt serviced at 5.75% over 7 years, and a FIRR of 10% (Energy for Environment 2004).

7.6 Sri Lanka[21]

Sri Lanka currently has a feed-in tariff that is not very different from Thailand's SPP program. The Ceylon Electricity Board (CEB), Sri Lanka's state-owned electric utility, purchases electricity generated by renewable energy generators under a Standard Small Power Purchase Agreement (SPPA) between the renewable energy generator and CEB. The SPPA is valid for 15 years. CEB reviews its generation plans, absorptive capacity, the potential of the proposed plant, and other variables, and issues a Letter of Intent to the prospective power producer. The tariff is governed by a Standard Small Power Purchase Tariff and its computation is based on the avoided cost (as is the case in the Thai SPP program). The avoided cost is calculated every December by the CEB to be used the following

[21] Also after Chris Greacen, Ph.D., (Palang Thai); Detlef Loy, Dipl.-Ing., (Loy Energy Consulting); which got informations from Mr. Nagendran at the World Bank in Sri Lanka by telephone and email exchanges. Much of this section is based verbatim on Mr. Nagendran's emails.

year. For 2005 the average avoided cost tariff is 5.49 Sri Lankan Rupees per kWh (2.21 Baht per kWh), comprising a wet season tariff (9 months) of 5.30 Rupees per kWh (2.14 Baht per kWh) and a dry season (3 months) tariff of 6.05 Rupees per kWh (2.44 baht per kWh). This rate is provided regardless of the firmness of the renewable energy generator: there is only an energy component (kWh), no capacity component (kW) to the tariff. The tariff is accompanied by a guarantee that the future tariff paid to each renewable energy generator will not fall below 90% of the tariff paid on the first year. By comparison, the typical average tariff received by CEB is about 8 Rupees per kWh (3.22 Baht per kWh). The tariff levied by CEB varies widely, depending on the type of user (domestic, industrial, commercial etc), quantity consumed (prices follow a progressive block-rate tariff like Thailand) as well as other arrangements such as bulk supply, time of day etc.

Starting in 2006 it is likely that electricity generated from biomass will receive a flat tariff of Rs 8.50 (3.42 baht/kWh), with the difference between the SPPT discussed above and this figure subsidized by a fund to be administered by the state owned Energy Conservation Fund (ECF). The top-up tariff will likely apply only for the first 50 MW of biomass plants. The subsidy added reflects the Sri Lankan government's decision that biomass provides important benefits including diversification of electricity supply, firm dispatchability, rural employment benefits (growers of fuel wood), national economic growth in a new industry, relative freedom in locating the power plant in optimal grid locations to minimize transmission and distribution losses and environmental benefits (leaves from fuelwood plantations such as *gliricidia sepium* provide fodder and organic fertilizer).

Energy source	**Wet season (baht/kWh)**	**Dry season (baht/kWh)**	**Average (baht/kWh)**
All renewables	2.14	2.44	2.21
Biomass (likely starting 2006)	3.42	3.42	3.42

Feed-in tariffs in Sri Lanka

Since the biomass feed-in tariff has not yet been implemented, it is premature to discuss the outcome. However, market take-off has been exponential for small hydropower. Between 1997-2002, 31 MW of mini hydro capacity was added through 15 projects. For 2002-2007 an additional 46MW has already been completed through 18 projects, with another 75 MW through 25 projects approved by banks and are at various stages of construction. However, growth is expected to slow down as most of the commercially feasible sites have been picked. A senior World Bank official working on renewable energy in Sri Lanka estimates that the country has potential for about 300 MW of small hydropower in total (Nagendran 2005).

8. Summary

FITs are simple. They put a legal obligation on utility companies to buy electricity from renewable energy producers at a premium rate, usually over a guaranteed period, making the installation of renewable energy systems a worthwhile and secure investment for the producer. The extra cost is shared among all energy users, thereby reducing it to a barely noticeable level.

FITs are effective at overcoming the various barriers that confront market entry for renewables, which can be summarised as follows:

- costs and pricing: distorted 'playing field' through subsidies for competing energy sources; fluctuation of oil and gas prices; high initial capital costs; environmental externalities
- legal and regulatory: lack of legal framework for independent power producers; planning restrictions; grid access; liability insurance requirements
- market performance: lack of access to credit; perceived technology performance uncertainty and risk; lack of technical or commercial skills and information [Beck and Martinot, 2004]

A good feed-in law can overcome many barriers to market entry for RE producers. For example, the German Renewable Energy Sources Act:

- gives RE priority access to the grid obliges
- grid operators to purchase electricity from renewable sources
- sets the price for RE electricity for long, fixed periods
- sets no limit to amount of RE feeding into the grid.

Well designed and implemented FITs can also:

- support installations of different sizes and technologies: in addition to large RE projects for wind, solar, biomass etc, householders can now get a guaranteed pay-back on a solar roof in just a few years, rather than 20–30 years
- promote innovation: annual reduction of tariffs for new installations drives technological efficiency
- drive economies of scale: investment and demand are rising, and manufacturing expansion is taking place globally in response, lowering costs further over time
- promote stability: change of government does not affect the system, as it does not cost taxpayers anything through taxes, and so cannot be cut from the national budget
- promote public support: through public participation in the scheme, no direct taxpayer costs, simple administration, and increased awareness of the benefits of RE
- create fair market participation conditions for every energy provider.

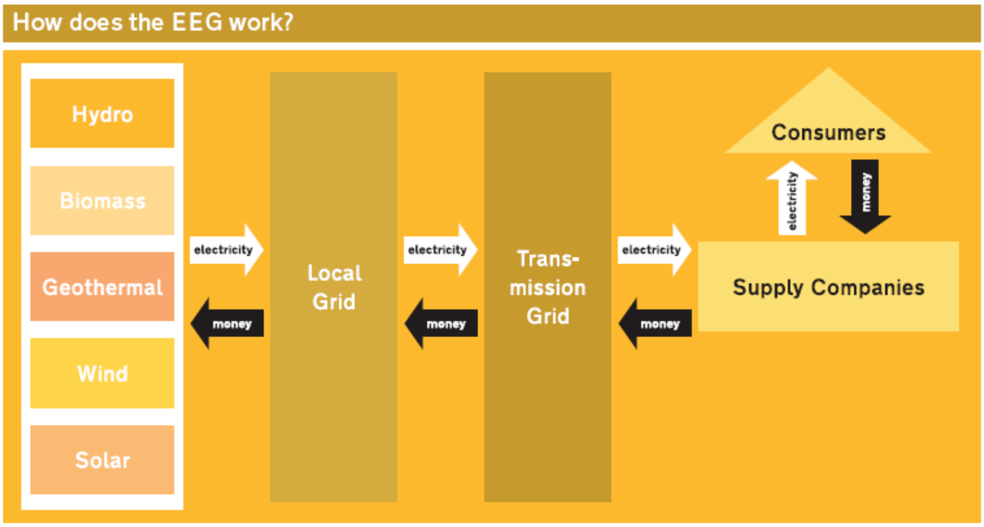
All this is possible when the FIT is designed and implemented properly!

The diagram below shows the simple mechanism of the German version – the Erneuerbare-Energien-Gesetz (EEG) - 2004, or Renewable Energy Sources Act 2000.

Already applied in over 40 countries, states and provinces around the world, FITs have helped to accelerate the switch from fossil fuel energy to renewable energy. They have been a highly effective tool for boosting the viability, and hence value, of the renewables industry.

FITs have been empirically proven to generate the fastest, lowest-cost deployment of renewable energy, and with this as a priority for climate protection and security of energy supply, not to mention job creation and competitiveness, FITs are the best vehicle for delivering these benefits.

"A frequent criticism of the Feed-in Tariff is that it does not generate sufficient competition. However, our analysis revealed stronger competition among turbine producers and constructors under the feed-in tariff than under either of the UK schemes." (Butler and Neuhoff, p 31)



Source: Viertl, 2004

Three steps to a FIT

1. Evaluate your domestic conditions in terms of: renewable energy resources, political environment, economic environment, geographical conditions, and technological preconditions; determine the desirable and possible rates of increase in RE in terms of capacity and share in the energy mix; assess the state of the national electricity grid and the level of connection across the country. Identifying comparable conditions in other countries where a feed-in law has already been implemented will be helpful. It is critical to ensure that the public is backing the uptake of renewables, so practice effective communication of the benefits and opportunities of RE.

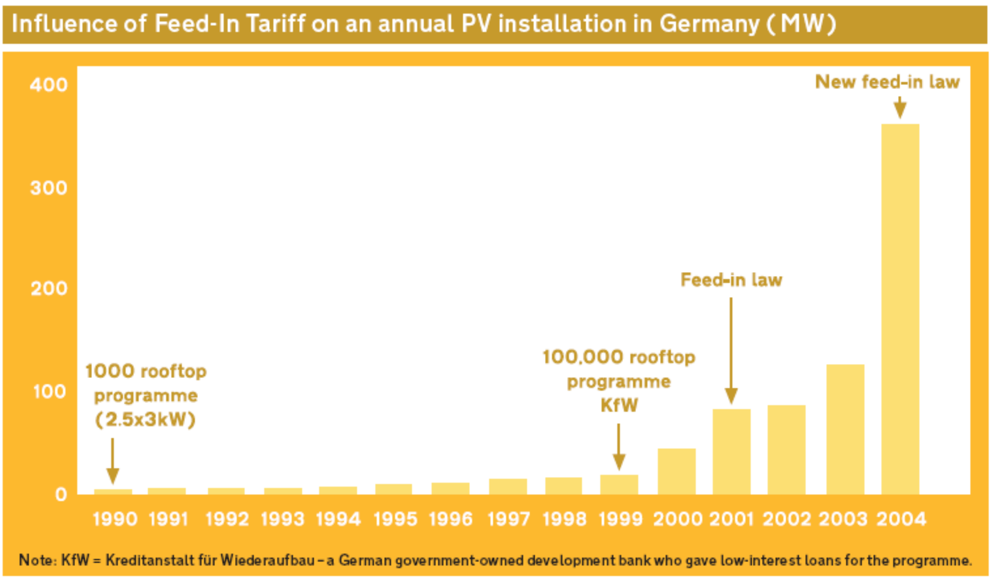
2. Find partners to help push the political process. They should be independent from the conventional energy industry, and must be ready to argue against

it if necessary. Ensure that Parliament and Government are ready for such a system – and are not unduly influenced by the traditional energy industry.

3. Start with a comparatively simple regulation and improve it over time. Therefore, there should be a monitoring process within the regulation in order to check if the goals and targets are being met. Tariff rates should also be monitored and adjusted in order to control expansion rates and ensure correct payments for each technology as it matures. For more detailed information, see the WFC book on FITs.

Some countries have opted for other instruments, such as government grants schemes for microgeneration (domesticscale wind and solar), funded by the taxpayer. In the UK and elsewhere, these grant schemes have been massively oversubscribed and have done comparatively little to stimulate the introduction of renewable energy at the domestic level.

FITs, on the other hand, can kick-start the domestic renewable energy market without requiring large government subsidies. And yet, they do not create a notable burden on anyone else either. It amounts to around an extra € 1.50 per household per month in Germany. By contrast, the UK's 'Renewables Obligation' system, which uses another mechanism known as a 'quota' system to promote large-scale renewables deployment, costs a similar amount, yet has produced only a small fraction of the renewables expansion, job creation, market development and CO2 savings.



Source: EPIA, 2005

The FIT system means that the pay-back time for PV is no longer several decades but several years instead. Micro hydro power plants reach even shorter pay-back cycles. In countries such as Germany and Spain the demand for renewable energy systems has risen dramatically and the installation costs are coming down fast. This financing model has now been taken up widely around the world, as the table below shows:

Countries, states and provinces that have adopted FITs		
Year	Cumulative number	Countries/states/provinces added that year
1978	1	United States
1990	2	Germany
1991	3	Switzerland
1992	4	Italy
1993	6	Denmark, India
1994	8	Spain, Greece
1997	9	Sri Lanka
1998	10	Sweden
1999	13	Portugal, Norway, Slovenia
2000	14	Thailand
2001	16	France, Latvia
2002	20	Austria, Brazil, Czech Republic, Indonesia, Lithuania
2003	27	Cyprus, Estonia, Hungary, Korea, Slovak Republic, Maharashtra (India)
2004	33	Italy, Israel, Nicaragua, Prince Edward Island (Canada) Andhra Pradesh and Madhya Pradesh (India)
2005	40	Turkey, Washington (US), Ireland, China, India (Karnataka, Uttaranchal, Uttar Pradesh)
2006	41	Ontario (Canada)

Source: REN21, 2006

FITs can be shaped according to a country's RE resources, its electricity distribution system and its RE targets. There are many design options to help take account of these variables, including some which make the system more compatible with liberalised energy markets (but carry higher investment risk). The important thing is that each technology is supported if viable. Some innovative technologies which are still at the demonstration phase of development may require a different type of government support, such as tax incentives or soft loans.

Proof of the effectiveness of the FIT model can be found in the following figures from Germany.

German achievements in figures:

- 214,000 jobs created
- 97 million tonnes of CO_2 emissions avoided in 2006 through renewables
- 11.8 % share of total gross electricity consumption from RES in 2006
- 5.3 % share of total primary energy consumption from RE in 2006
- € 21.6 billion total turnover in 2006 through RE (building and operation)
- € 8.7 billion investment per year reduction of around
- € 5.40 worth of environmental damage per household per month
- All this, at a cost of only around € 1.50 per household per month!

Additional References

Greacen, Chris; Detlef Loy: Feed-in Tariffs: International experiences and recommendations for implementation in Thailand; Joint Graduate School for Energy & Environment, Palang Thailand , March 2006

Gipe, Paul: Renewable Energy Policy Mechanisms, Ver. 04; Tehachapi, CA 93561 USA, February 17, 2006

Martinot, Eric (Global Environment Facility, Washington, DC): Grid-Based Renewable Energy in Developing Countries: Policies, Strategies, and Lessons from the GEF; WORLD RENEWABLE ENERGY POLICY AND STRATEGY FORUM, JUNE 13-15, 2002, BERLIN, GERMANY

Martinot, E. (2005). "Renewables 2005 Global Status Report." Worldwatch Institute & Tsinghua University.

Mendonça, Miguel: Feed-in Tariffs: Accelerating the development of renewable energy, Earthscan, Date: May 2007

Mendonca, Miguel: Energy, Ethics and Feed-in Tariffs, World Future Council, January 10, 2008

Minkoff, Kevin: Renewable Energies Pilot Project, Nelson Mandela Bay Municipality, Port Elizabeth 2008

Mitchell, C., D. Bauknecht, et al. (2003). "Risk, Innovation and Market Rules: A Comparison of the Renewable Obligation in England and Wales and the Feed-In System in Germany." Warwick Business School. C:\Documents and Settings\jimwill14\My Documents\Thailand\E for E\Wind and solar policy study\International\UK

NN: Global Status Report on Renewables 2007 (www.ren21.net)

Policy Action on Climate Toolkit (PACT): What is a FIT Law?, World Future Council (online) 2007

Sawin, Janet L.: National Policy Instruments - Policy Lessons for the Advancement & Diffusion of Renewable Energy Technologies Around the World; Thematic Background Paper, Worldwatch Institute, January 2004; Editing: Secretariat of the International Conference for Renewable Energies, Bonn 2004

SEPCo Document Library: Renewable Energy Policy in Germany; (Sepco Sustainable Energy Policy Concepts - Background Paper) 2008

David Toke: Making the UK Renewables Programme FITTER - The Renewables Obligation, the general case for a feed-in tariff and the feasibility of a feed-in tariff for small renewables. A submission to the 2007 Renewables Obligation reform consultation, World Future Council August 2007

Zhu Li: China's renewables law, in: Renewable Energy World, July-August 2005

Zijun Li: China's Renewable Energy Law takes effect; Pricing and fee-sharing rules issued, Worldwatch Institute, 18.01.2006